MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 37 JANUARY, 1931 Number 5

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MACHINERY

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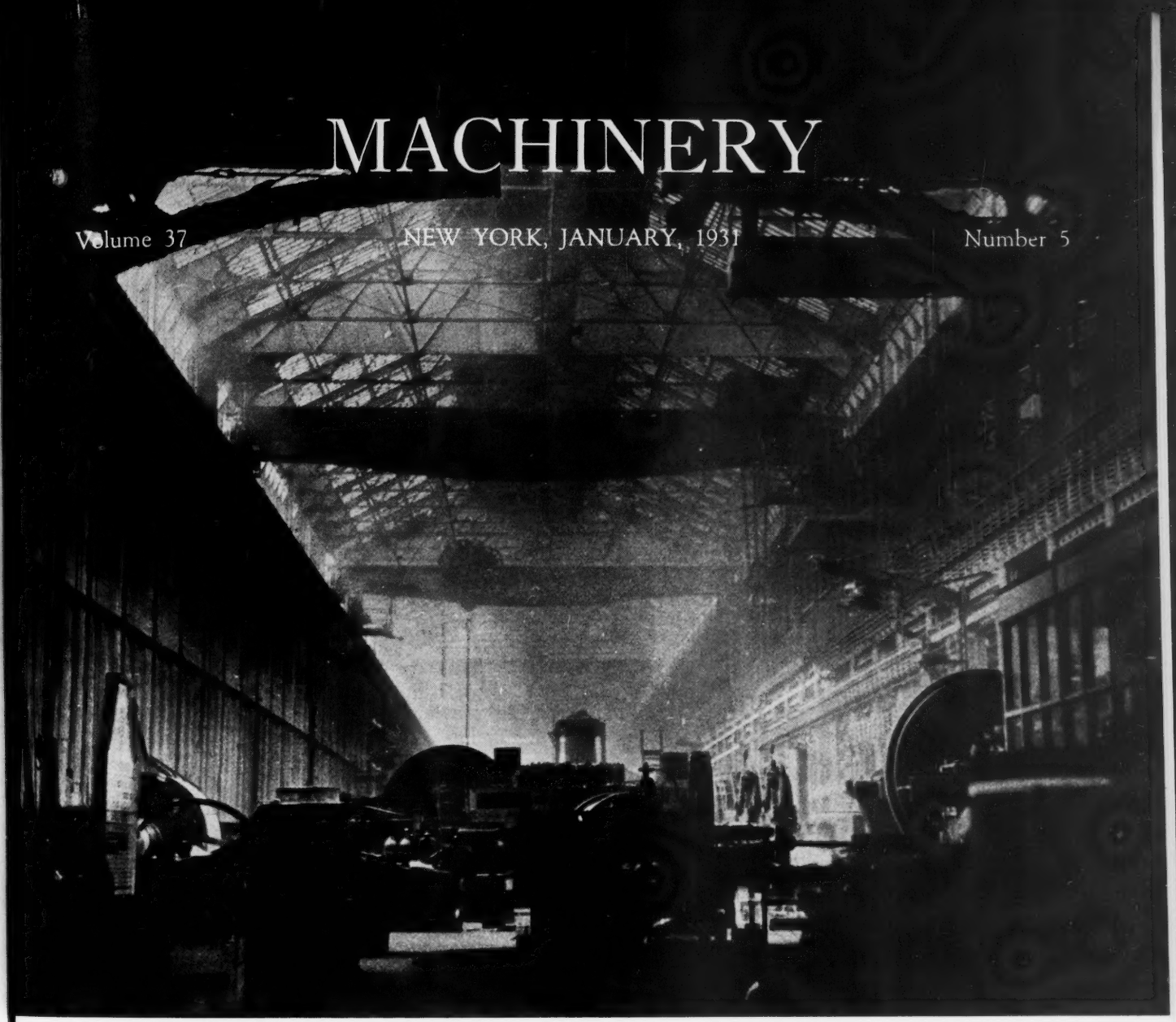


Courtesy of Westinghouse Electric & Mfg. Co.

A Forecast For 1931

Based on Ascertainable Facts

By ALVAN T. SIMONDS, President
Simonds Saw and Steel Co.

Alvan T. Simonds, for many years, has made a thorough study of the factors that influence industrial production. He has found that there are certain economic relationships that make it possible to forecast accurately the trend of industrial production a year in advance. It is on the basis of such a study of economic factors that he outlines, in the present article, the trend that business is likely to follow during the coming year. Mr. Simonds emphasizes that this forecast is not a guess or a mere opinion, but a conclusion arrived at by interpreting ascertainable business facts. The accuracy with which he has forecast trends in the past adds weight to his statements.

EVERY reader of this article, like the reader of a detective story, will probably want to know at once how the story is going to turn out. Someone has suggested that in detective stories the author should place the last chapter first and then go on with his story. The present article deals with a subject that is of vital interest to every business executive. To calm his mind, we will give the concluding chapter—the forecast for 1931—at the beginning. Briefly, it is as follows:

The volume of production of the factories and the mines of the United States (as reported in the

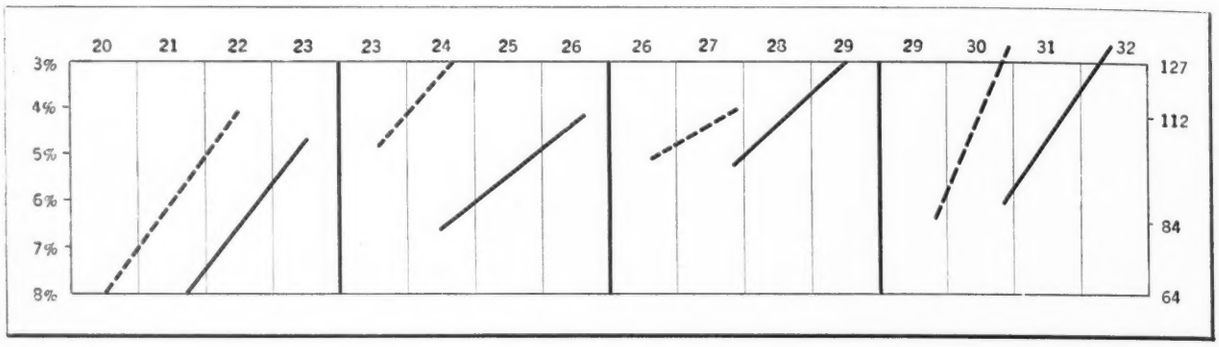


Chart 1. The dotted lines show commercial paper rates, New York City, reversed. The heavy lines show the volume of industrial production as reported by the Federal Reserve Bulletin.

Federal Reserve Bulletin and by other reliable agencies) will increase through the year 1931 toward the next peak, which will probably come in the first half of 1932.

This statement is not a hunch, a guess, or an opinion. It is a forecast based on a study of economic facts—it is made by observing an economic factor. The major movements of this factor, which appears to record the combined effect of a great many, if not of all, economic influences, have proved reliable in forecasting correctly, many months in advance, every major swing in industrial production since the close of the World War. That being the case, the reader may decide for himself whether or not he believes that a forecast for 1931, made by a study of this economic factor, is going to prove true.

Now those who have no further interest in the matter, or who do not like the way the story has turned out, may give their attention to some other subject; but for the sake of those who find that they learn by reading—for those who want to know the whys and wherefores—the subject will be dealt with in greater detail.

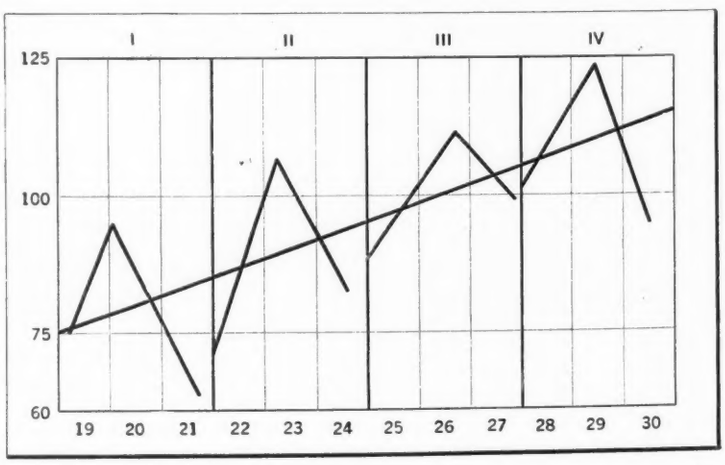
The Value of Charts in Presenting Facts

Even in detective stories, charts are used because they make the facts clearer than thousands of words could do. Many business executives do not realize that this is true, and have not learned to read a chart so as to obtain from it quickly the important facts. One who is skilled in reading a chart will often discover facts that the ordinary person would overlook. An effort has been made to make the charts used in this article extremely simple, so that they can be understood even by those who are not accustomed to reading charts.

In making the charts, the curved line with its ups and downs of minor fluctuations has been discarded, and the straight line is used to indicate the long swing, by connecting the extreme high point with the extreme low point. This straight line is like a line that might be drawn from the source of a river to its mouth. The Charles River, probably familiar to most readers of this article, is a short historic river that rises about thirty miles southwest of Boston and winds its way southward, westward, northward, and eastward, finally emptying into Boston Harbor. It twists and turns, but in its entire course, there is never a point as high as the source nor as low as the mouth.

In the same way, the straight lines used in these charts connect the highest point of the major swing with its lowest point. Between the ends of each straight line there is no other point as high as the upper end, nor as low as the lower end. These lines show the direction or trend, or, as statisticians say, the direction of the trend, of each movement. In Chart 1, the dotted lines represent upward major movements in money rates reversed. The solid lines represent upward swings in the volume of industrial production. To simplify and emphasize, only the upward swings are indicated, because, as already stated, the next swing ahead is to be upward. The declining swings may be filled in by simply making the proper connections on the chart.

Chart 2. The diagonal line running from 75 to 115 is the long-time trend of the volume of industrial production. This line shows an annual gain in production of 3 1/3 per cent; it is often estimated as high as 4 per cent. The hills shown by the solid lines are the peaks of industrial production based on 100 as normal, which is the average of the three years 1923, 1924, and 1925.



Relationship Between Interest Rates and Industrial Production

Money rates decrease as the volume of loanable money funds increases, and vice versa. Since 1919 there have been four upward swings in money rates reversed; that is, there have been four periods in which the credit reservoir was filling up. These are shown by the four dotted lines in Chart 1. Following each of the first three of these periods of filling up, there came, about a year later, an increase in the volume of industrial production, as shown by the solid lines. The fourth period in which the credit reservoir filled up (this time very rapidly) we have just passed through, from December, 1929, to the present date. This is shown by the dotted line in 1930.

A solid line is drawn through 1931 into 1932. This line is believed to represent, very nearly, the trend of business through 1931. No one can forecast this absolutely; but there is no reason to doubt that the fourth upward movement in money rates reversed since the war will be followed, as were the first three, by a corresponding upward movement in industrial production. It was thought that this upward movement might begin as early as August, 1930, but it is shown in Chart 1 as beginning at the end of December, 1930. It is not even now certain whether business struck the low point at the end of July or in December. Had it not been for the drought and the election, without question the low point would have come in the middle of the year.

The sharp upward slant of the line during 1931 should not be understood to mean that there will be a correspondingly sharp and unbroken rise in business. Business in 1931 will probably show many minor ups and downs, with the usual major Spring peak and minor Fall peak, and the usual Summer downward drop.

Four Cycles of Industrial Production

Chart 2 shows how the volume of industrial production since the war has moved up to a peak and down into a valley, forming a hill every three years. Using the average of 1923–1925 as a base line equal to 100, the peaks climb to 93 in 1920, 108 in 1923, 114 in 1926, and close to 125 in 1929. The fall in 1930, below the base line, was about 10 per cent, thus making the drop from the peak in 1929 to the bottom in 1930 about 35 per cent of the base value. From the peak in 1920 to the bottom in 1921, the drop was 29 per cent.

Using the trend line as a base, the peaks of 1920, 1923, and 1929 are all about 16 per cent above, while the peak of 1926 is only 10 per cent above. The bottom in 1921 was 20 per cent below; in 1924, 10 per cent below; in 1927, 5 per cent below; and in 1930, 23 per cent below. The most extreme fluctuations come after similar fluctuations in money rates. The fluctuations from 1925 to 1928 were comparatively slight, following money rates that fluctuated from 4 1/2 to 3 per cent. The conclusion of this article draws a lesson from this fact.

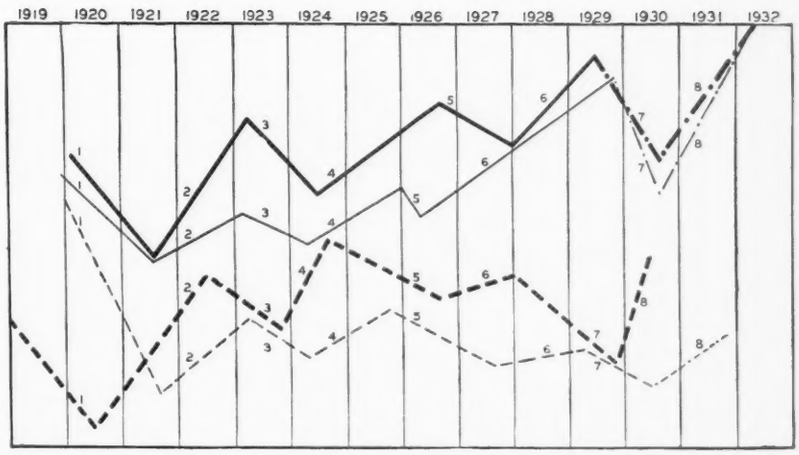


Chart 3. The heavy dotted line is commercial paper rates, New York, reversed. This shows the swings in credit supply. It is the forecaster preceding the other business factors in their cyclical fluctuations. The heavy solid line is the volume of industrial production, Federal Reserve Bulletin. The light dotted line is wholesale commodity prices, Guaranty Survey. The light solid line is industrial stock prices, The Annalist. Estimated movements are indicated by breaking the lines with dots. The forecasting line, money rates reversed, forecasts only the direction of the trend and the approximate length of the other lines. The lines on the chart are comparable only for direction and duration of trend. They represent the short cyclical swings by straight lines connecting cyclical peaks and cyclical low points. Minor fluctuations are omitted.

Do Not Let Opinions or Guesses Take the Place of Facts

One observer has said that simply looking at these four hills formed during the last twelve years makes it perfectly obvious that the next movement must be upward toward the peak of the fifth hill. Each reader is asked to use his own judgment, basing it not on this chart alone, but also on the other charts in this article, and on all other pertinent information obtainable. Do not, however, let the hunches or guesses of others modify an opinion founded on facts. Do not let the opinions of others modify a judgment based on facts unless these opinions are also founded on facts, clearly stated.

"Few men think, but all have opinions," said a wise philosopher more than a century ago. It is equally true today. Hunch has been fired by all intelligent business managers; his weak-minded brothers Guess and Ignorant Opinion should go too.

A Chart of Four Major Business Factors

Chart 3 was prepared for the issue of *Looking Ahead* of June 16, 1930. As already stated, we are

not certain at this writing whether the low point in 1930 came at the end of July or in December. It is certain, however, that industrial stock prices did not reach their low in July. As these are likely to move up a little before or at about the same time that business turns, this seems to indicate that the low point in business production may fall in December.

How to Reduce the Severity of the Next Business Depression

The question of how to mitigate the next boom is not raised, because no one seems to be interested in mitigating or reducing booms. This is an outstanding weakness of all human beings and is therefore true of bankers and business managers. On the other hand, business men are now saying: "Would it not be a great thing if the depression of 1930 could be the last serious depression in American business?"

It is probably impossible to keep the road of business perfectly level; and even if it were possible, it would not, perhaps, be desirable. But President Hoover said some years ago that the only way in which we can lessen depressions is to take off from the peak that precedes a depression to fill up the depression ahead. Since this statement was made, it has not been successfully contradicted. So far as the author knows, the truth of it has not been questioned.

Thoughtful students of business must conclude that if another boom comes in 1932, it will be followed by another depression. If the boom goes to extreme heights, the depression following it will go to extreme depths. The charts in this article show that extreme fluctuations in the volume of business are preceded by extreme fluctuations in the cost of borrowing money. Since November, 1929, to date, there has been an extreme fall in the cost of credit, that is, in money rates. This will doubtless be followed by a corresponding rise in the volume of business during 1931 and into 1932.

If this occurs, money rates are almost certain to increase from the present low of from 2 to 3 per cent to an abnormally high rate. This movement is likely to begin about the middle of 1931, although it might begin earlier or later. The main point to remember is that if, from that beginning, whenever it comes, money rates keep on increasing to an extreme level, such an increase will be followed, beginning about a year later, by a turndown in business into another serious depression.

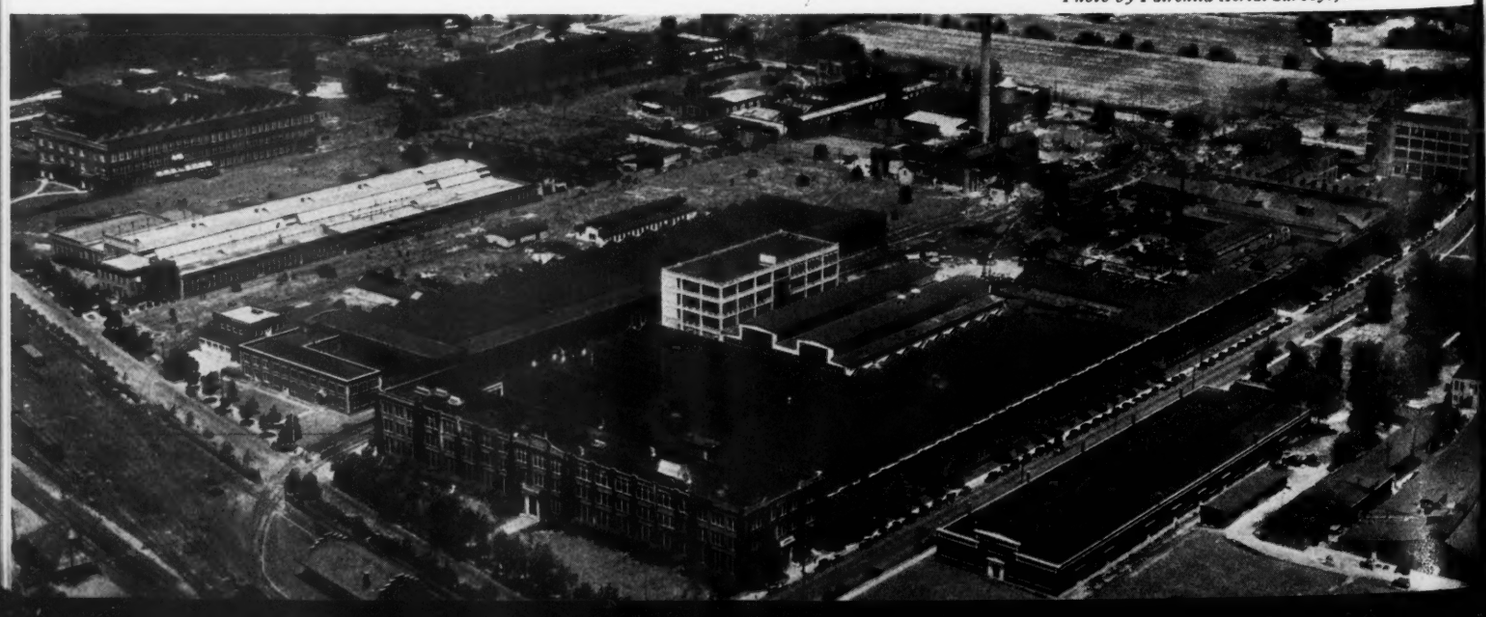
Being Conservative During Booms and Courageous in Depressions will Help Stabilize Business

The years 1925, 1926, and 1927, as already mentioned, show that by avoiding extreme fluctuations in money rates, extreme fluctuations in business may also be avoided. It is too late now to avoid the extreme swing in money rates from November, 1929, to date. Perhaps most people will think that it should not have been avoided; but this extreme swing means that the upward swing in business will go to extremes, unless all concerned take steps to prevent it. If, when business begins to move upward, it moves too rapidly and too far, this will cause an extreme rise in the cost of credit, which will inevitably be followed by a serious decline in business. Business excesses may be the chief cause of emptying the credit reservoir, as was the case in 1919 and 1920; wild speculation may be the chief cause, as in 1929.

Business men generally can assist in preventing the next rise in money rates from going to extremes. In an article like this, nothing more can be done than to point to this one thing, which we can all help to accomplish. While speaking of it as one thing, it is probably the one influential factor that represents the effect of nearly all other economic factors. In looking ahead through 1931, then, let us keep our attention fixed on the point when interest rates begin to turn upward, and then watch this upward swing and our business commitments with great care. The author believes that if the facts stated in the concluding paragraphs were appreciated by everyone who desires to keep the road of business more nearly level, this desire could be realized.*

*For some years past, Mr. Simonds has devoted much time and gone to considerable expense to further an understanding of the fundamentals of economics in the business world. He is particularly interested in inducing every business man to use his influence in keeping money rates from rising to abnormal heights during 1931. In a leaflet entitled *Looking Ahead*, published every two months, he gives a resume of his observations. Anyone who wishes to be placed on the mailing list to receive *Looking Ahead* regularly is asked to send his request to John G. Thompson, Assistant to the President, Simonds Saw and Steel Co., 470 Main St., Fitchburg, Mass. The publication is sent free of charge.

Photo by Fairchild Aerial Surveys, Inc.



Unusual Balancing Problems

Methods of Analyzing and Eliminating Excessive Vibrations Due to Mechanical and Electrical Unbalance and Other Causes

By PETER DAVEY, Vice-president
Vibroscope, Inc., New York City

MANY field balancing jobs are simple and require only a few hours' work, whereas others are much more difficult, especially when excessive vibrations are not the direct result of mechanical unbalance. For example, vibrations caused by electrical unbalance, faulty bearings, shifting weights, loose couplings, foundation troubles, etc., may be very misleading, and haphazard attempts to correct such conditions often lead to weeks of useless work. The few balancing jobs referred to in this article have been selected out of a large number because they presented unusual difficulties. In analyzing these vibration troubles in the field or under service conditions, the Davey portable balancing equipment was used. The operation of this equipment was fully described in March, 1929, MACHINERY, page 532, but the general features will be summarized briefly for the benefit of those not familiar with the apparatus.

Operation of Equipment Briefly Described

The heading illustration shows this equipment applied to a motor-generator set for checking the balance. One operator is shown holding the "breaker head" into the center of the shaft, while the other is holding the hand lamp in which a neon tube is mounted. The driving of the breaker head at shaft speed causes the neon tube to flash once per revolution, and each flash gives an instantaneous glimpse of the rotating member, so that it will appear to be standing perfectly still. In this case, chalk numbers from 1 to 12 have been marked around the face of the commutator, and the operator holding the hand lamp can read these numbers plainly, no matter how fast the armature is rotating. Suppose he sees the armature apparently standing still with number 12 at the top; then if the other operator turns the phase adjuster on the breaker head through 180 degrees, the number 12 will appear 180 degrees further on in the revolution, or at the bottom. Thus the motion may be arrested at any desired position.

The vibrometer is shown resting on metal blocks with its contact pin against the bearing pedestal of the machine, so that it will indicate the vibration amplitude at that point. Fig. 1 shows how the vibrometer is held in contact with a machine in some cases. The oscillation of a beam of reflected white light on the ground glass scale shows the amplitude or extent of the vibration. The vibrations are magnified about 500 times, and the scale is graduated in thousandths of an inch. The oscillating beam has the appearance of a solid band of light.

A red beam of light from a second neon tube mounted within the vibrometer is reflected on the scale just above the white band, and the instantaneous position of the vibrating movement of the part being tested may be seen from the position of this red beam. Since both neon tubes are controlled by the breaker head, the turning of the phase adjuster will cause the red beam to move to different positions on the scale, and by noting first the point at which the red beam rests and then the position of the numbers as shown by the hand lamp, the exact relation between the rotary and vibratory motions is shown.

Fig. 3 shows the appearance of the white light band and red beam on the vibrometer scale. It will be noted that the phase adjuster has been set so that the red beam is at the extreme right. With this setting, if the rotating part is observed with the hand lamp, the number that coincides with the horizontal center line on the side of the machine adjacent to the vibrometer, gives the exact position of the "high spot" that is, the spot that is thrown over toward the vibrometer with each revolution of the unbalanced part.

Fig. 1. The Vibrometer which Indicates the Amount of Vibration at any Point and the Probable Cause of the Vibration

The balancing of a motor for a ventilating set developing 175 horsepower at 5200 R.P.M. showed in a striking manner that unbalance could be responsible for excessive bearing temperatures and high power consumption, in addition to annoying vibrations. This motor had been through a balancing machine, but after assembly in its bearings, it had been found unsafe to operate it in excess of 2000 R.P.M. The motor was run at 1800 R.P.M. for a preliminary balancing test with the portable equipment described in the foregoing.

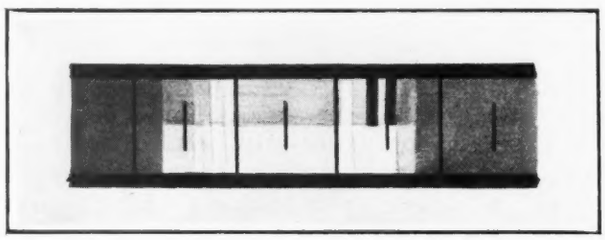


Fig. 2. The Vibrometer Reading in This Case Indicates Excessive Bearing Clearance which Had to be Eliminated before Balancing

The light beams on the vibrometer scale showed instantly that it was useless to attempt balancing operations on account of a chattering and inconsistent high-spot reading (as shown in Fig. 2) obviously caused by loose bearings. On inquiring into the bearing clearances, it was found that these were almost 50 per cent over normal. The excessive clearance had been found necessary because the temperature rise at the bearings was 80 degrees C. on light load at 1800 R.P.M., when the specification called for a maximum of 40 degrees C. at full load. This necessitated frequent changing of oil, but it was decided to tighten up the bearings to normal clearance and risk a short run.

The vibrometer reading then showed a clearly defined white light band with a steady red beam, as illustrated in Fig. 3, indicating clearly that all bearing trouble had disappeared and only a condition of pure unbalance remained. The application of a counterbalancing weight at the indicated point immediately decreased the vibration amplitude on the next run, and at the same time the temperature rise was less than before, in spite of tighter bearings. As the vibration condition was improved, the balancing speed was raised until it became safe to run at 5200 R.P.M., and with each improvement, the bearing temperature dropped until the final rise was under the specified 40 degrees C. At the same time, it was noted that the light load driving current dropped 25 per cent, clearly indicating the amount of energy which was being wasted by the unbalanced condition.

Vibrations in a Steamship

The two main turbo-alternators of an electrically driven liner called for an unusually accurate balance, and the time available for completing the work was only four days while the ship was in port between trips. These units operated at 2800 R.P.M., and although they did not appear to be very much out of balance, showing maximum vibration amplitudes of only about 0.0017 inch, they were the cause of really severe vibrations in some of the cabins three decks higher up, where amplitudes as high as 0.005 inch were indicated.

The couplings between the turbines and alternators were chosen as the most convenient places for numbering, and numbers from 1 to 12 were marked around their peripheries with white chalk. Readings were taken first at all bearing pedestals to determine whether any trouble might be expected from bearings, foundations, or couplings, which would have to be corrected before proceeding with the balancing. At each point the white light bands on the vibrometer scale were continuous and sharply defined, and the red beams stood still where set, as shown in Fig. 3, indicating clearly that the vibrations were of "sine wave" form and were caused by unbalance alone.

During the first run of each unit, the following information had been gained: (1) All vibration caused directly by unbalance; (2) accurate vibration amplitudes at two ends and each side of the center bearing; (3) accurate high spots at two

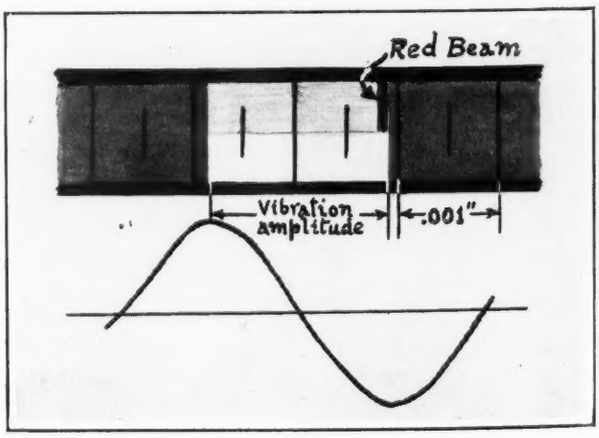


Fig. 3. Uninterrupted White Beam of Light and Stationary Red Beam on Vibrometer Scale, Indicating Ordinary Mechanical Unbalance

ends and each side of center bearing; (4) close estimate of "angle of lag" at turbine side of center bearing. The angle of lag is the angle between the high spot (representing the extreme deflection in one direction) and the heavy spot that causes vibration. (For more complete information see March, 1929, MACHINERY, page 532.)

Determining Relation between High Spot and Heavy Spot that Causes Vibration

The high spot having been found, it does not follow that this is the actual heavy spot, for it is well known that the vibratory motion lags behind the rotary motion, and the angle between these two spots, or the angle of lag, may have any value up to 180 degrees. To measure the angle of lag, the behavior of the red light beam on the vibrometer scale is observed while the rotating member is coasting down under its own momentum.

If the red beam remains at the extreme right of the white band while the rotating member coasts down, then there is no angle of lag and correcting weights must be placed directly opposite the high spot; but if the red beam moves over to the extreme left while coasting down, the angle of lag is 180 degrees, and correcting weights must be placed right on the high spot.

In each of the turbo-alternators referred to, the red beam started to move over to the left as soon as the steam was shut off, and moved nearly to the extreme left, indicating that the angle of lag was a little under 180 degrees, the first estimate being 150 degrees. That is to say, the heavy spot was estimated to be 150 degrees ahead of the high spot, and the first test weight to counterbalance the heavy spot was therefore placed 30 degrees behind the high spot or 180 degrees from the estimated heavy spot.

In each case, the vibration amplitude was decreased, but while the port unit showed the same high spot on the next run, indicating that the high spot estimate was correct, the high spot on the starboard unit moved slightly forward, indicating that the angle of lag had been under-estimated. The second estimate on the starboard unit was 160 degrees, which proved to be correct. The vibration in the cabins became almost imperceptible, showing a maximum amplitude of 0.0002 inch, and the balancing was completed in twelve hours under the allotted time.

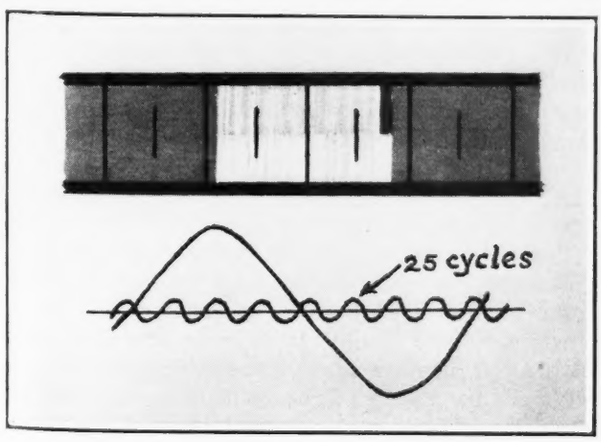


Fig. 4. An Electrical Vibration Superimposed Upon Mechanical Unbalance as Indicated by the Small and Large Curves

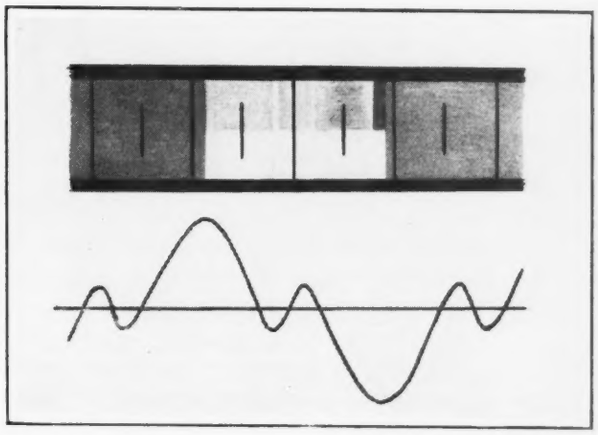


Fig. 5. This Double Curve Indicates Mechanical Unbalance Plus a Smaller Vibration Characteristic of a Defective Ball or Roller Bearing

Mechanical and Electrical Vibrations Combined

A 17,000-kilowatt vertical hydro-electric unit, with a rotor weighing about 125 tons, developed excessive vibrations in service although the speed is only 165 R.P.M. During the first run, amplitude and high-spot readings were taken at various points, starting at the floor level and working up. A compound vibration was shown by the white light band, which was streaky in appearance, as shown in Fig. 4, but the position of the red beam was not affected, indicating a 25-cycle electrical vibration superimposed upon the low-speed vibration due to unbalance. The high-spot readings were the same at all points, but the vibration amplitudes increased steadily to a maximum of 0.005 inch at the top of the machine, indicating the probability of unbalance at the top. Therefore, a point in line with the top bearing was chosen for checking the angle of lag while the machine was slowing down.

Starting with the red beam set at the extreme right of the white band, it remained at the right as the machine commenced to slow down, finally moving slightly toward the center before the machine came to rest. This indicated that the angle of lag was comparatively small, and 35 degrees was chosen as a first estimate. That is to say, the heavy spot was estimated as being 35 degrees ahead of the high spot, and, therefore, to counterbalance this heavy side, a large test weight was placed 35 degrees ahead of the point opposite the high spot.

The second run showed a slight decrease in vibration amplitude, but the high spot had moved slightly forward in the revolution, showing that the angle of lag had been under-estimated. The original weight was, therefore, advanced 10 degrees and another one added at the same point; this resulted in a big decrease of amplitude and the same high-spot reading on the third run, showing that 45 degrees was the correct lag angle. Weights

which finally amounted to some hundreds of pounds were placed at the same point, and then the machine showed an amplitude of only 0.0004 inch. It is interesting to note that the 25-cycle vibration decreased and disappeared when the balancing was completed, showing that it was due to the effect of unbalance in the air gap.

A High-speed Turbo-blower Requiring Slight Weight Changes in Balancing

In balancing a high-speed turbo-blower, the behavior of the red light beam showed immediately why previous efforts at balancing had been unsuccessful. This large unit was operating at 8500 R.P.M., and it developed unbalance in the turbine end after overhauling. The vibration amplitude increased all the way up to the operating speed, reaching a maximum of about 0.008 inch. After the first run, when checking the angle of lag, the red beam, starting from the right, moved rapidly across the scale and stopped at the center. This showed that the angle of lag was 90 degrees and that the machine was, therefore, operating at its critical speed; furthermore, the rapid movement of the beam indicated that the foundation had considerable resilience. It was therefore obvious that the machine would be sensitive to very small changes of weight, and this proved to be the solution of the problem, the corrections being accomplished by drilling small holes in the wheels, and, when necessary, in the final stages, by countersinking some of these holes.

Causes of Electrical Unbalance

Electrical unbalance is a condition frequently encountered in units driven by induction motors, particularly of the two-pole type. This condition is often inherent in the design, so it cannot be cured in the field, but when it exists in conjunction with mechanical unbalance, it is of great importance to know exactly how much there is of each condition, so that the mechanical unbalance may be corrected down to the required limit, after which no time need be wasted in trying to effect further improvement.

Electrical unbalance is mainly due to one or more of the following causes: (a) Lack of perfect symmetry in the windings; (b) incorrectly centered rotor; and (c) shaft flexure, especially when the air gap is small. In the latter case, the electrical unbalance will be corrected automatically when the mechanical unbalance is corrected, but in the other cases it will remain.

One interesting instance of the mistaken identity of electrical unbalance was uncovered when the vibrations in a pump driven by a large induction motor were analyzed. This pump was handling hot oil, and for safety, the pump and motor were placed in separate rooms with a brick wall between them, through which the shaft passed. When standing in the pump room, a rythmic surging noise could be heard, and this had been diagnosed as surge in the delivery of the pump.

A vibrometer reading, taken on the end of the pump adjacent to the motor, showed that electrical unbalance was probable, and a reading on the motor itself proved conclusively that this was the cause of the surging noise, which was being transmitted along the shaft into the pump room.

The light beams on the vibrometer scale clearly indicated the combined presence of mechanical unbalance, electrical unbalance, and a chatter at the peak of the vibration wave. The latter was obviously due to the normal "sine wave" vibration receiving a sharp impact as it reached its peak, and was found to be caused by the rotor hitting the spacing rings as it revolved.

Some Other Causes of Vibration

Distorted ball and roller bearings will occasionally produce vibrations that cannot be corrected by balancing. The characteristic vibration in such cases is of the form shown in Fig. 5. Experience to date has shown no remedy but to change the bearing.

A large blower driven by an induction motor at 3600 R.P.M., in addition to a probable mechanical unbalance and a slight electrical unbalance, showed this characteristic bearing vibration unmistakably. After several trials, it was proved that balance weights were of no avail. One of the ball bearings was therefore changed, and the next run showed only mechanical and electrical unbalance, the latter disappearing as the former was corrected by the application of weight. Another case of a large alternating-current motor with a ball bearing at one end and a roller bearing at the other showed at once that the roller bearing was faulty, and changing it cured the trouble.

Any shifting weight in a rotating member can be recognized instantly by the action of the red light beam, because the latter will not stand still within the white band. The case of the generator end of a turbine unit is an example. All efforts to balance it had been unsuccessful; it had been noticed, however, that the balance would improve, but only momentarily. The vibrometer reading showed that the red beam would not stay at the extreme right, but would swing over to a position in the white band equivalent to about 50 degrees in the cycle. A loose member was therefore sought, and the trouble was found to be due to a temporary lead balance weight which had become loose and was rolling around between two points about 50 degrees apart. This was removed, thus saving further waste of time in trying to balance the unit.

The wave form of any vibration that is not of "sine wave" character can be easily plotted on cross-section paper. This is done by turning the phase adjuster in steps of, say, 10 degrees at a time, and plotting the displacement of the red beam against degrees. (See Fig. 5.) This is sometimes valuable in determining the cause of troublesome vibration. The balancing equipment referred to in this article is made by the Electrocon Corporation, 6 Varick St., New York City.

Making Steel Axle Housings by Arc Welding

Producing Light-weight Rear Axle Housings by Joining Steel Stampings on an Automatic Arc Welding Machine

By J. M. ROBINSON, Lincoln Electric Co., Cleveland, Ohio

AUTOMOBILE manufacturers are constantly striving to improve the performance and reliability of their products without increasing the weight. To achieve this object, parts of lighter weight made of new materials having greater strength are continually being substituted for the more bulky parts previously employed. Electric arc welding, which has lately come into wide use in the automotive industry, has made it possible to use steel stampings in place of heavy castings for many important parts. This naturally results in lighter and stronger construction.

In the plant of the Oakland Motor Car Co., the electric arc welding process has been adopted for the manufacture of rear axle housings. In Fig. 1 is shown the automatic machine designed for welding together the two steel stampings that form a rear axle housing. The final operation in preparing the steel stampings for welding is known as a restrike. It consists of placing the two stampings in a large press having a die that strikes the edges to be welded.

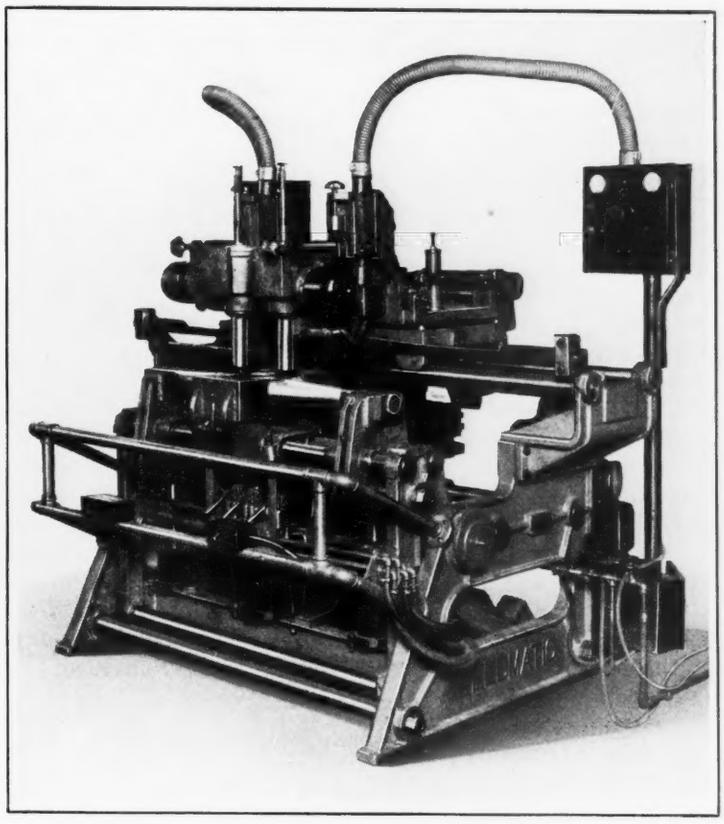


Fig. 1. Automatic Arc Welding Machine which Joins the Two Halves of a Rear Axle Housing

This restriking operation serves two purposes: It straightens the edge, so that the two halves of the housings will fit evenly, without any gap between the edges over which the Electronic Tornado welding heads of the machine are to pass, and it also upsets the housing along the edge, thereby increasing the thickness of the material at the point of weld. This additional material makes possible a fusion of the two halves to a depth that insures adequate strength along the welded seam. Since no metal is added in using the Electronic Tornado carbon arc welding process, and since a housing must have great torsional strength, it is necessary to fuse the edges together to a depth equivalent almost to the thickness of the material used.

In order to insure sufficient strength, the restriking operation is required to upset the metal about 1/16 inch along the edge. This gives a thickness of material at the point of weld of approximately 1/4 inch, while the sheet itself is only 3/16 inch thick. By having a thickness of 1/4 inch at the point of weld, it is possible to fuse the two edges of the housing together to a depth of approximately 3/16 inch, thus giving maximum strength along the seam.

The two halves of the housing are held in a fixture on the welding machine by three clamps, one at the center of the housing and one at each end. These clamps are so designed as to follow the contour of the housing. In Fig. 2 the clamps are shown tilted back to receive the work. The housing is placed in the machine and the center clamp closed first. This aligns the two halves perfectly and brings the seams together in accurate alignment. The two end clamps are then closed, insuring a straight seam which can be easily followed by the welding heads.

As the two end clamps are closed by an air valve, a button is pressed and the two welding heads *A* and *B*, Fig. 3, which are located on traveling units operated by a revolving screw, simultaneously feed the carbons *C* and *D* downward and strike the two arcs at the beginning of the seam. The weld is always started at the center hole in the housing, which forms the differential gear-case. After the arcs are struck, the carbon stands still for approximately two seconds to obtain proper fusion and penetration at this point of the weld. At the com-

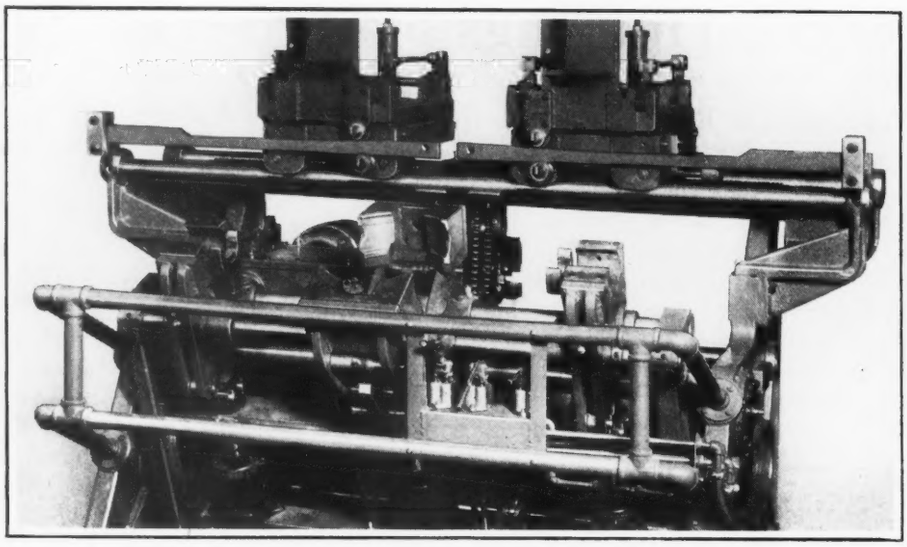


Fig. 2. Machine with Clamps Open Ready to Receive Work, and with Welding Heads Removed to Show Traveling Carriages

pletion of this time, the two heads move off toward the ends of the housing, traveling at a constant speed.

The arcs are broken simultaneously just as they reach the two ends. As soon as the arcs are broken, the two heads start traveling back toward the original position at a speed which is five times the welding speed, and as this is being done, the fixture comes into the loading position where the operator opens the clamps and turns over the housing. The fixture then travels to the welding position, and the cycle is repeated.

The entire process, which consists of welding four seams of 20 inches each, is completed in less than two minutes. The loading and the turning over of the housing takes less than half a minute, so that one machine turns out approximately twenty-five housings per hour. As these machines are fully automatic and the operator only has to load and unload them, a production of fifty to fifty-five housings per hour is obtained from two machines operated by one man.

The strength and ductility of the weld made by this process is such that the housing can be twisted into all sorts of shapes before breaking. The welds are very ductile and can be readily machined. The metal in the weld is also free from carbon, since the housing is made positive and the current flows from the housing to the carbon; thus the burned carbon passes off into the air as a gas.

After the welding operation is completed, the housing is ready for the application of the bearing retainers and the spring seats. Steel stampings are used throughout. The bearing retainers are made of two stampings and are drawn, formed, and flash-welded to the two ends of the housing simultaneously on a machine designed by P. W. Fassler of the Fisher Body Corporation. This flash-welder is of 300-kilowatt size, and has clamps which hold the housing in place while the bearing retainers are being welded to each end in one operation. The time required for flash-welding both bearing retainers to the axle housing is less than three seconds.

The spring seats are next arc-welded in place by hand. The reason for using a hand-operated arc welder in preference to an automatic machine on this job is because the welding time is so short that more time would be lost in putting the housing into the fixture and removing it than would be gained by using an automatic machine.

The completely welded all-steel rear axle housing produced as described is stronger than the old housing made up of steel and cast members. It is also very much lighter than the old housing and is more economical to produce. It may be interesting to note that the axles are held to a uniform length within 0.001 inch.

* * *

When capital is in the form of cash, it is carefully protected, its receipt and disbursement safeguarded and its custodians held to a strict accounting, but once this capital is converted into materials, there is a tendency to become lax, to lose sight of the value of the investment, to husband the capital less diligently, and to tolerate practices that are wasteful, inefficient, and needlessly expensive.—*C. Hanneford Smith.*

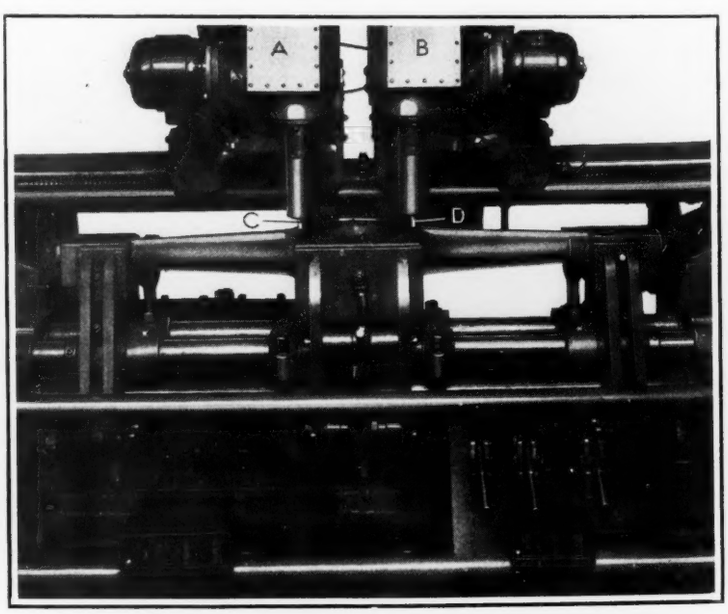
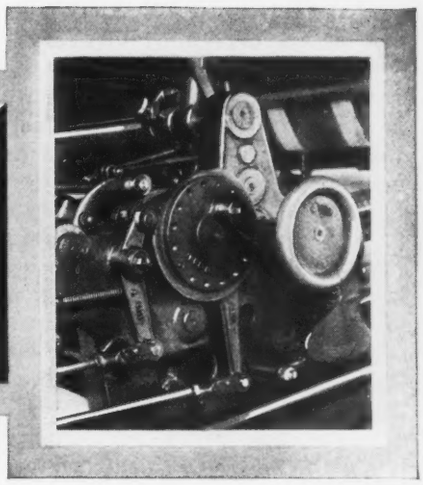


Fig. 3. Close-up View of Welding Machine with Work in Place and Arc Welding Heads in Position for Starting the Welds

Ingenious Mechanical Movements

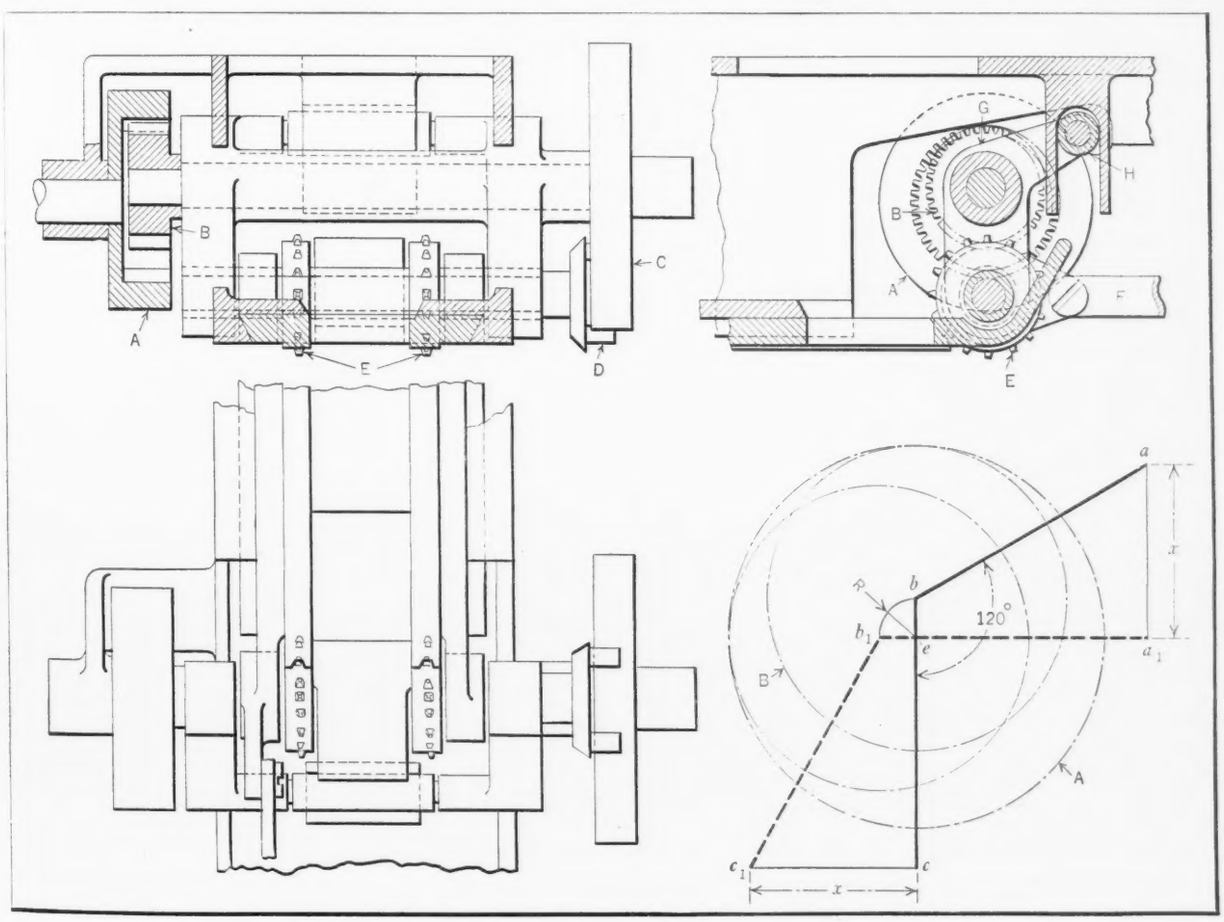


MECHANISM COMBINING STRAIGHT-LINE AND CIRCULAR MOVEMENTS

By CHARLES HORTON

Motion picture projectors are designed to give the film a rapid intermittent movement, stopping it sixteen times every second. These dwelling periods in the movement of the film are so timed that the light is projected through the film only when it is stationary. Moving pictures, therefore, are in reality a series of sixteen stationary pictures projected on the screen every second at normal operating speed, and owing to the "persistence of vision" this rapid succession of still pictures causes the successive views to blend into one another and produce the effect of continuous motion.

The edges of the film have accurately spaced perforations which are engaged by teeth on a double sprocket *E* (see illustration). The drive to this sprocket is through the internal driving gear *A*, the



Mechanism of a Moving Picture Projector which Makes it Possible to Adjust Film Sprocket Along a Straight Line without Interfering with its Intermittent Drive

driven gear B, driving disk C of the intermittent motion, and driven member D on the sprocket shaft. This driven member turns 1/4 revolution for every complete turn of driver C, and this quarter turn of D occurs during one-fifth of the revolution of C. During the remaining four-fifths of a turn of C, member D is locked in the stationary position.

Thus far, the mechanism described is similar in principle to that used on motion picture projectors in general. However, this mechanism has an original feature which makes it possible to shift the film sprocket E from, say, its lowest position, which is the one illustrated, to a higher position, without interfering with the intermittent drive and while this drive is in operation.

It was discovered accidentally that four points in a plane may be so located relative to one another that two of these points, if moved along straight lines perpendicular to each other, will cause a third point to describe an arc about the fourth; thus, if points a, b, and c on the diagram are located properly, the movement of point a to a_1 and of c to c_1 will cause point b to describe an arc of radius R about point e.

Before describing the essential requirements in this design, its practical application will be explained. This application is illustrated by the diagram just referred to, in conjunction with the sectional view just above it, which represents the actual mechanism.

The line abc of the diagram represents the center line of the arm G. When the axis of the sprocket E is shifted along a straight line, as indicated on the diagram at cc_1, the axis of roller H moves along a perpendicular straight line aa_1. In conjunction with these two straight-line movements, the axis of driven gear B (represented at b on the diagram) describes an arc bb_1 of 90 degrees. As this arc is concentric with the axis of driving gear A, driven gear B continues to mesh properly with A during the straight-line movement of sprocket E, which is the requirement.

From what has preceded it will be evident that, in designing this mechanism, the problem is to so proportion the angular arm abc that when c and a move along straight lines at right angles, point b will follow a circular arc having a radius R equal to one-half the difference between the pitch diameters of gears A and B. To obtain this circular movement of point b, the design must be according to the following requirements:

Points a and c must be equidistant from point b.

The angle between arms ab and bc must be 120 degrees. If x equals the length of the straight-line movement, and y equals the dimension ab or bc, then,

$$y = \frac{x}{\cos 30^\circ \ (2 \cos 30^\circ - 1)} = 1.57x$$

$$\text{Radius } R = \frac{x}{2 \cos 30^\circ - 1} \times \left(\frac{1}{\cos 30^\circ} - 1 \right) = 0.21x$$

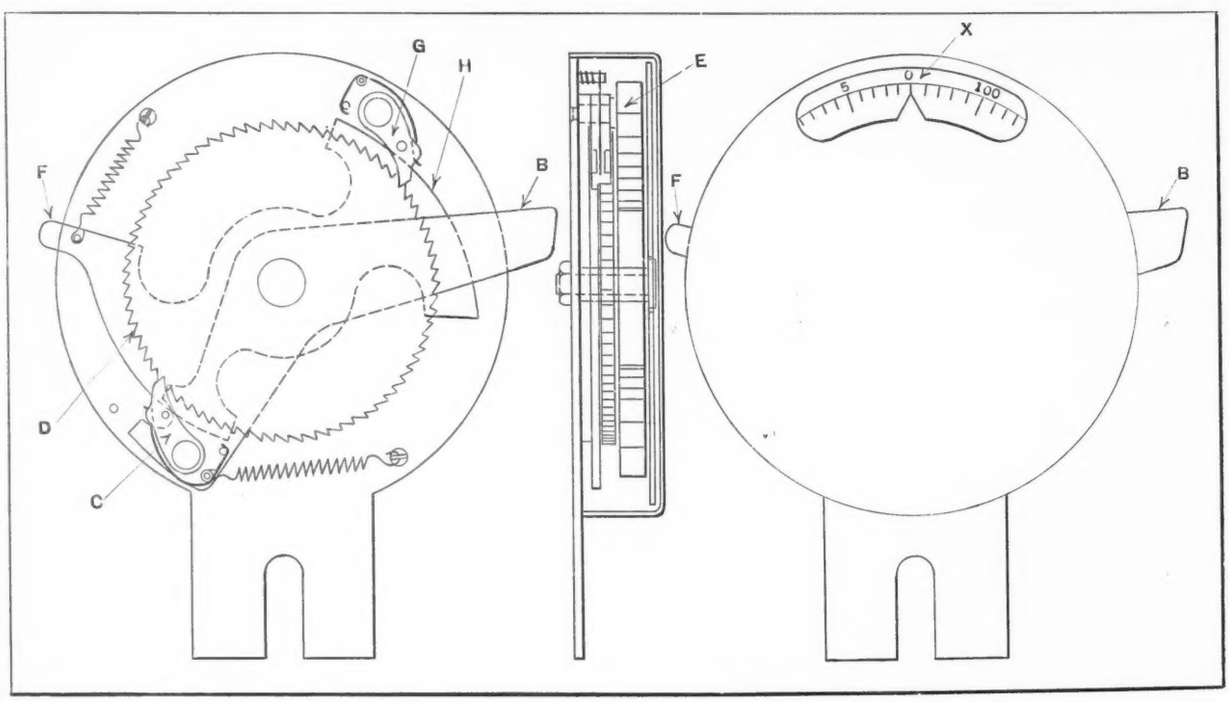
The movement of sprocket E is effected by a hand-lever connected with link F. This adjustment in the position of the sprocket is only used when an improperly made splice in the film requires what is known as "framing."

* * *

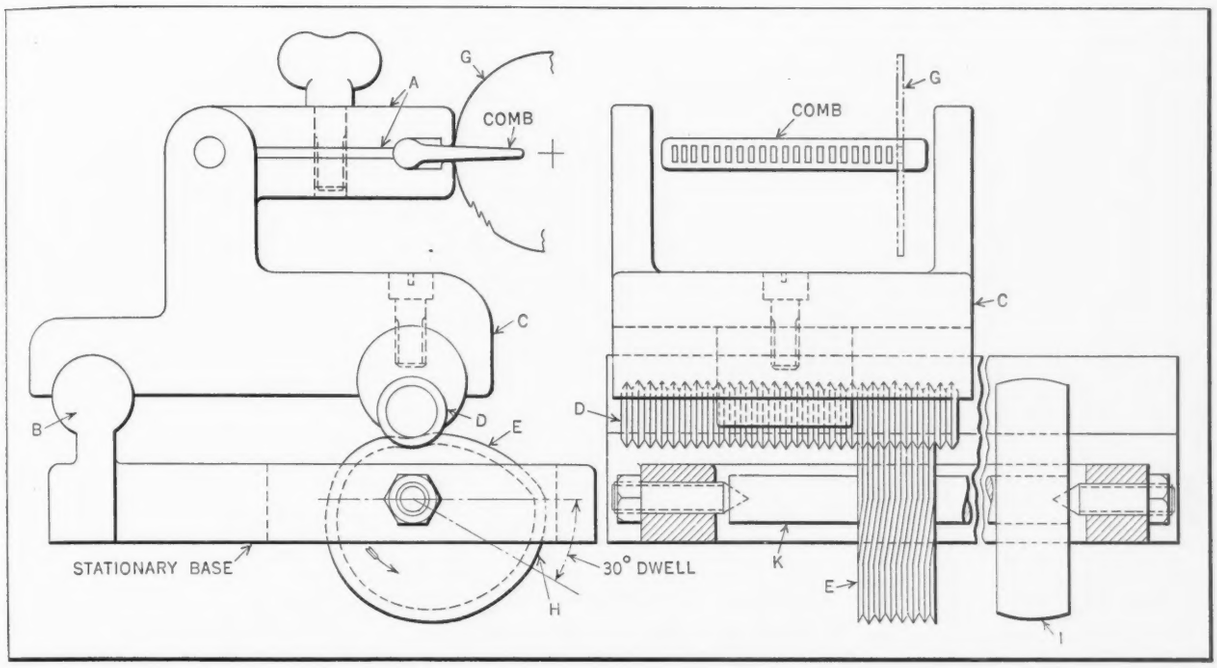
RAPID-RETURN COUNTER

By J. H. RODGERS

In setting type on a linotype machine (for lay-out pages), it is necessary to count each line in the different sections so that the type set will agree with the lay-out calculations. With the instrument



Automatic Counter with Rapid Return Mechanism



Mechanism in which a Cam Imparts an Oscillating Movement Followed by a Horizontal Indexing Movement

shown in the illustration, however, no mental effort is required, as the actual count is registered automatically on the dial at *X*, which is returned to its zero position by one simple motion of the operator's hand.

The lower part of the counter is bolted to a stationary bracket on the frame of the machine. An adjustable finger attached to a reciprocating member on the machine strikes the end of the lever *B*, causing the pawl *C* to advance the ratchet wheel *D* one tooth, or one graduation on the dial. The dial continues to register until the required number of lines to be cast is indicated. The operator then depresses lever *F*, causing the dial to return once more to the zero position ready for the next group of lines.

When the lever *F* is depressed, the cam-plate *H* forces the pins in pawls *C* and *G* outward, disengaging the pawls from the ratchet wheel and allowing the clock spring *E* attached to both cam-plate and dial to return the dial to the zero position. Stop-pins (not shown) are provided to limit the return movement of cam-plate *H* and lever *B*, as well as that of the dial on its return to the zero position. The counter is located on the machine so that the dial is at right angles to the line of vision, assuring easy and accurate reading.

* * *

DOUBLE-ACTING INDEXING CAM

By GEORGE L. NUHN

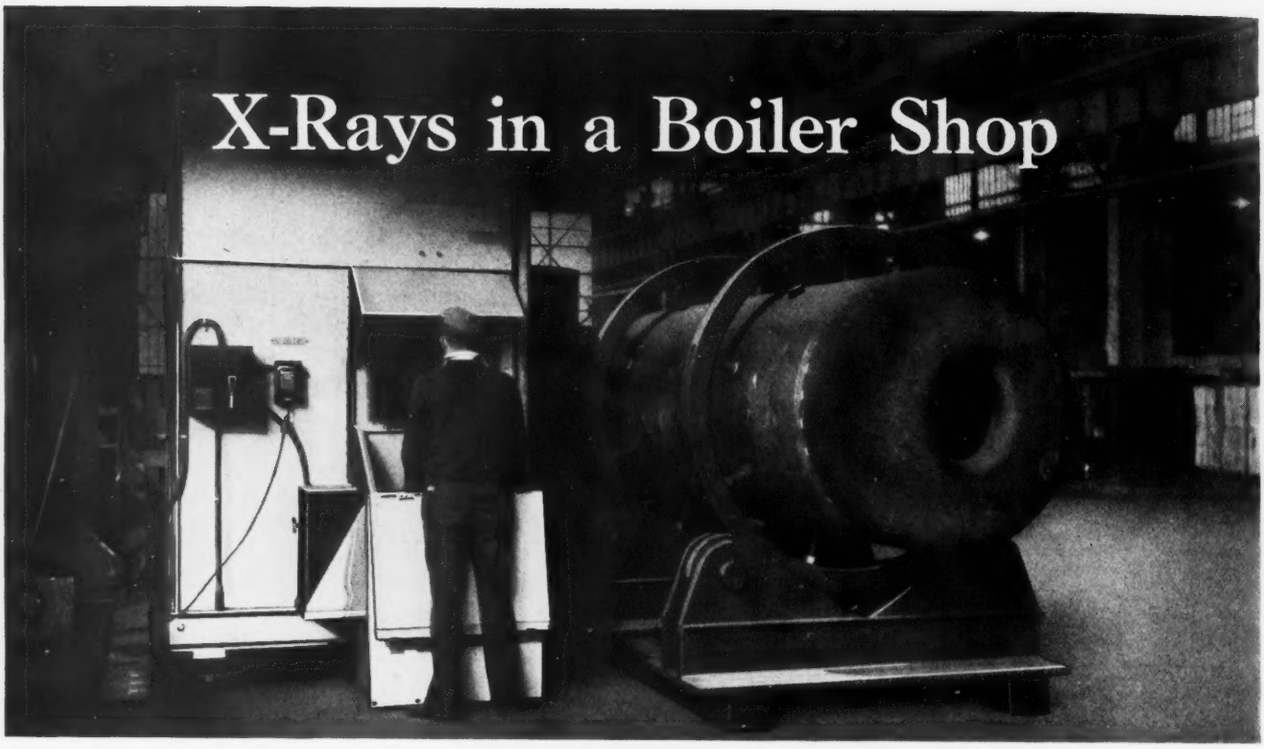
In the mechanism shown in the illustration, a cam is used to impart an oscillating movement, as well as a horizontal movement, to the table of a machine for sawing teeth in combs. A comb is clamped rigidly between the straps *A* on the table *C*. This table oscillates about the bearing *B* and receives its motion from the cam *E* acting against the follower *D*. The cam is driven by a belt passing over the pulley *I*. The circular saw *G* revolves in stationary bearings, the comb being fed to it by the oscillating action of the table.

The principal feature of this cam motion is the manner in which the horizontal movement is imparted to the comb for cutting the successive teeth. On the outside of the cam is cut a continuous V-groove which engages corresponding grooves in the follower *D*. The several turns of the groove on the cam follow a parallel plane perpendicular to the center line of the shaft *K* until they approach the dwelling portion *H*, where they are deflected to one side a distance equal to the pitch of the groove. This pitch is also equal to that of the slots being cut in the comb. The grooves in the follower, however, are not continuous but are a series of separate grooves.

In the position shown, the table is at its lowest point and the saw has just completed cutting a tooth in the comb. As the cam continues to revolve in the direction of the arrow an upward movement is imparted to the table. When the dwelling surface of the cam has come in contact with the follower, the comb is clear of the saw, and the horizontal or indexing movement of the table begins, continuing until the follower has passed over the angular portion of the cam groove. Further movement of the cam carries the table downward, causing the comb to be fed against the saw for cutting the next tooth. This completes the cycle of operations.

The follower *D* does not revolve in actual operation, but can be adjusted to present new wearing surfaces. The design of this mechanism permits the use of interchangeable cams and followers for slotting combs having teeth of different pitches.

X-Rays in a Boiler Shop



A Non-Destructive Method for the Routine Inspection of Fusion Welds in High-Pressure Boilers and Tanks

By CHARLES O. HERB

X-RAY apparatus has been used successfully during recent years for investigating internal defects in parts made from metal. This type of equipment, however, has been applied mainly as a laboratory auxiliary for studying castings, forgings, welds, etc., with the aim of improving the methods by which they are produced. In other words, the application of X-ray equipment heretofore has not been for the routine inspection of work passing through the shop.

Thus a forward step in obtaining work of high quality was taken recently by the Babcock & Wilcox Co. when this concern installed X-ray apparatus at its Barberton, Ohio, shops for the routine inspection of fusion welded tanks and boilers as a part of the regular process of production. The heading illustration shows that this apparatus is installed right in the shop, housed in such a way that there is little to remind an observer of the laboratory. This equipment was designed by the St. John Service Corporation, 505 Fifth Ave., New York City.

Why X-Ray was Adopted in This Boiler Shop

The taking of X-ray pictures or "radiographs," as they are properly called, was adopted in this shop because it is possible to inspect the quality of welds by this method without destroying or harming the finished product. The X-ray method gives positive pictures of weld interiors that are self-explanatory to the inspector.

X-ray inspection is especially valuable as a final check of welded seams in pressure vessels which are to be used in high-pressure or high-temperature service, such as oil refinery pressure vessels of various types which must withstand pressures up to 1000 pounds per square inch and over, and temperatures as high as 900 degrees F.

Steam boilers have been built and are in operation that deliver steam at pressures up to 1500 pounds per square inch. There is no standard pressure in steam boiler practice, but there is an unmistakable tendency toward the use of higher pressures, more and more units being designed and built to operate at from 1000 to 1400 pounds per square inch.

Up to the present time the Boiler Code Committee of the American Society of Mechanical Engineers has not finished its contemplated code covering welded boiler drums, but the Bureau of Engineering, U. S. Navy, has ordered twenty-four boilers for the new scout cruisers *Minneapolis*, *New Orleans*, and *Astoria*, which are to have drums with welded seams. One of the most important reasons why the Bureau adopted welded construction was because of the facilities for making X-ray examinations of seams in order to verify the soundness of the welds.

Welds are X-Rayed the Full Length

High-pressure drums of the type shown in front of the X-ray booth in the heading illustration are constructed of a single rolled plate, welded longitudinally where the edges join, and two shaped heads, which are welded circumferentially to the main

cylinder. In Fig. 1 may be seen one of these drums prior to welding the heads in place. As soon as the longitudinal weld has been completed, the drum is brought to the X-ray equipment for the complete inspection of this weld.

Radiographs slightly more than one foot in length are taken to cover the extent of the weld. As a means of identifying the negatives obtained, small squares of lead plate with numbers stamped on them are attached along the boiler or drum just below the weld. These squares are spaced 6 inches apart and are held to the boiler side by pieces of tape. Punch marks in the squares facilitate spacing them the correct distance apart.

Before these lead squares are fastened, lines are scribed in chalk on the outside of the boiler so as to locate the squares with a fair degree of accuracy. Similar lines are scribed on the inside of the boiler so that the operator of the equipment can easily locate the film-holder within the boiler directly in line with the X-ray tube. The way these lead squares and their numbers show up in the radiographs may readily be seen in Figs. 2 and 3. By this means, it is a simple matter to locate any defects that may exist in the boiler. Between the different exposures, the X-ray apparatus is moved the required distance along the work.

Checking the Circumferential Welds

When X-raying of the longitudinal weld has been completed, the shell is returned to the welding machines for assembling the drum heads. Then the drum is returned to the X-ray booth again, and this time is placed in the rotary stand seen in the heading illustration. This stand is equipped with two large rings that revolve on rollers. The rings are provided with adjustable screws for lining the work up centrally on the stand.

Lead squares are located every 10 degrees apart around both welds, and the radiographs are of a length to cover 20 degrees. As before, lines are laid out in chalk on the inside of the boiler, as well as on the outside, to insure correct positioning of the negative holder.

Boilers and drums up to 12 feet in diameter can be X-rayed with the outfit here described. Thus far, the work has ranged from 4 to 10 feet in diameter and from 10 to 30 feet in length. Boiler walls up to 2 1/4 inches in thickness have been examined. The time required for taking the X-ray pictures varies with the thickness of the metal, the amount of time necessary for setting the negatives, etc., but on the average, fifteen feet of welded seams can be X-rayed per hour.

What the Negatives Show

From the radiograph negatives or the photographs reproduced from them, the inspector can detect readily any porosity, slag, cracks, or other defects that may exist in welds. Light spots or lines will be produced in prints made from X-ray negatives to correspond with defects in the work, because, obviously, at such points, more light can reach the negative from the X-ray tube.

Fig. 2 shows a portion of a radiograph of a weld that was so good that the weld metal cannot be distinguished from the parent metal. Fig. 3 illustrates another X-ray picture which

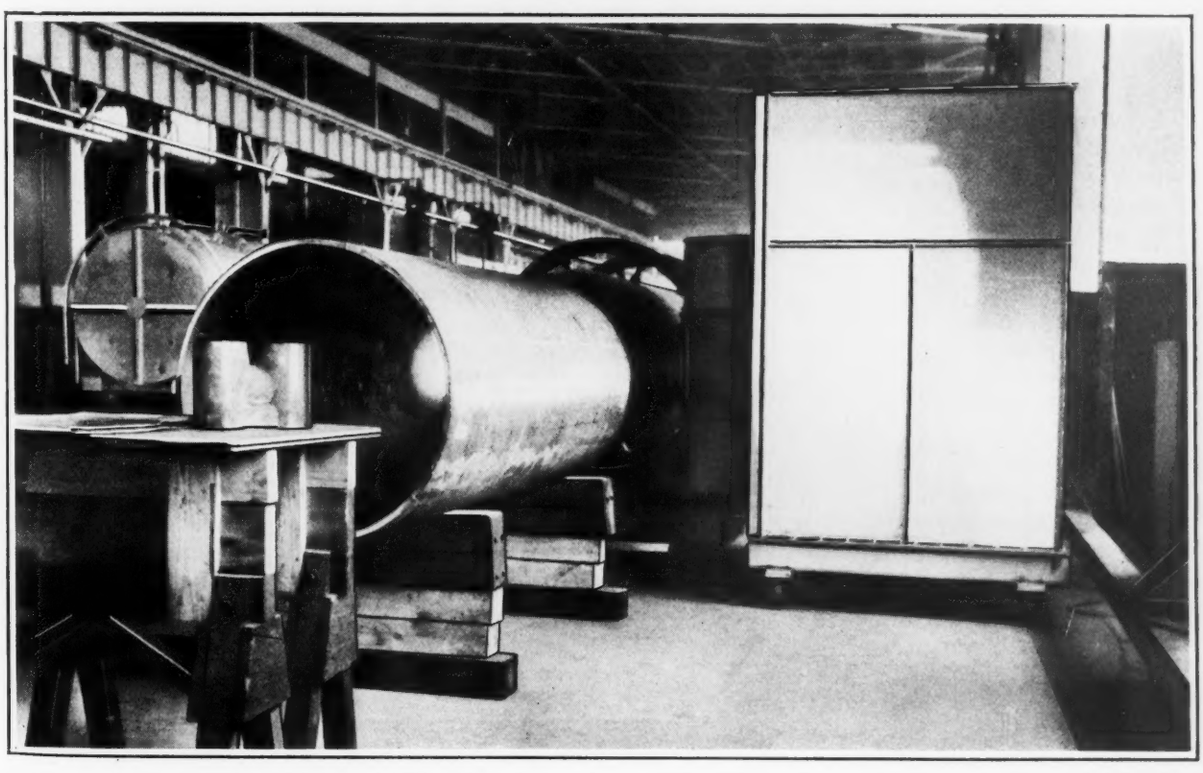


Fig. 1. All Boilers and Other High-pressure Vessels Fabricated by Fusion Welding are Inspected with the X-ray Apparatus

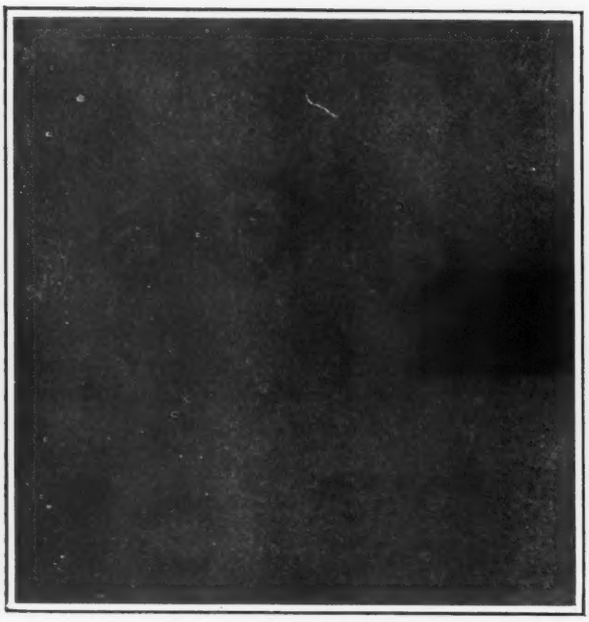


Fig. 2. X-ray Picture of a Weld So Good that it Cannot be Distinguished from the Parent Metal

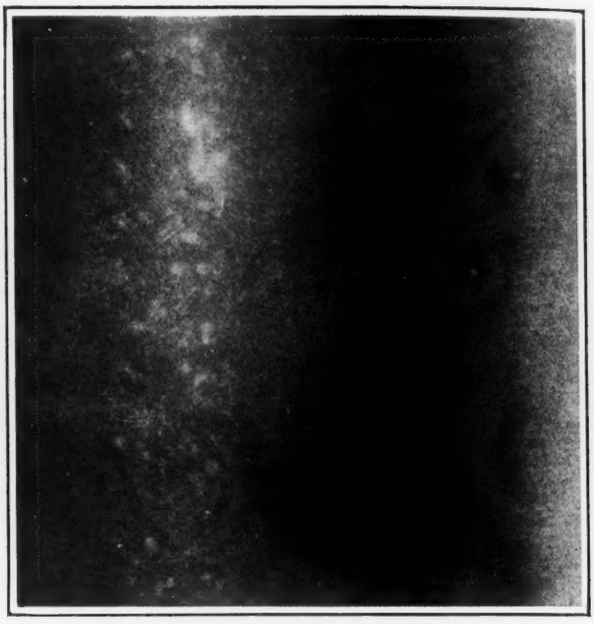


Fig. 3. White Spots in an X-ray Picture which Denote a Porous Condition of the Weld

shows a considerable number of light spots. These indicate porosity. This illustration is used here merely to show how defects in metal will be apparent in an X-ray picture—it is by no means a sample of the welds ordinarily made.

The operator of X-ray equipment need not be a highly skilled man, but he should be intelligent and careful. It is his job to produce X-ray pictures that can be easily interpreted by the metallurgist. He must first set up the work, scribe the chalk lines, fasten the lead squares, position the negatives, etc., and then turn on the required current for the proper length of time. All negatives made at the Babcock & Wilcox plant are filed for reference.

The X-Ray Equipment is Portable

The entire X-ray apparatus is contained in a sheet-metal housing mounted on rollers. The control box is located on the left-hand side, as shown in the heading illustration. This self-contained equipment is mounted on ball-bearing casters, so that it can be moved conveniently to any part of the shop for immediate use. However, the equipment is usually employed in the location illustrated, and therefore is equipped with guide rollers that run along the inside of the angle-iron seen near the floor at the right in Fig. 1. With this arrangement, the equipment is made to move parallel with the work as it is pushed along boilers for the various exposures. The housing measures roughly 5 1/2 feet wide by 8 1/4 feet long by 8 1/4 feet high, inside.

The X-ray tube is enclosed in the lead-lined sheet-steel turret shown in Fig. 4. It can be conveniently swiveled to any angle in a vertical plane, and the entire front of the X-ray housing can be adjusted up or down to position the tube at any height. Directly in front of the tube is an opening, measuring 4 by 14 inches, through which the X-rays are thrown on the work. Heavy sheets of leaded rubber are fastened around this opening, and these sheets are placed tightly around the surface to be X-rayed so as to guard against the escape of X-rays into the shop.

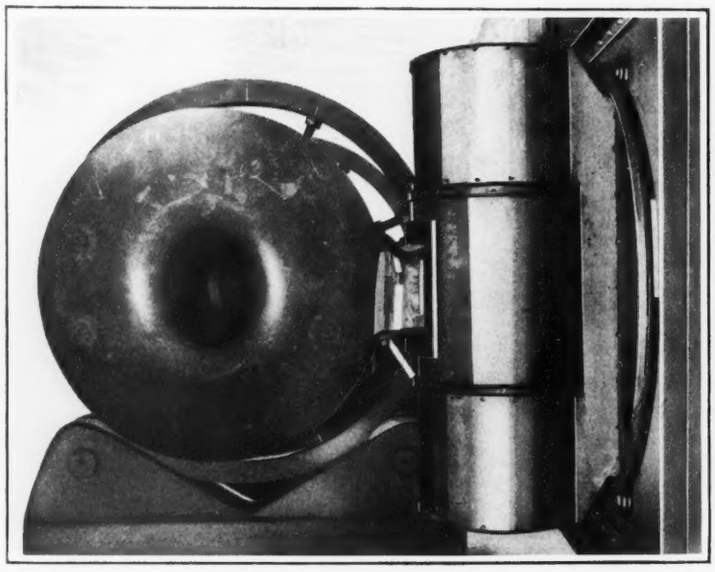


Fig. 4. Making an X-ray Exposure of a Typical Job

Negatives to be exposed are placed on the opposite side of the surface to be inspected. They are held in wooden frames which are also covered by lead plates. Before being placed in the frames, the negatives are wrapped in black paper and taped.

Simply expressed, the X-ray apparatus itself consists of a power plant capable of producing current of 250,000 volts, and a Coolidge X-ray tube. Single-

phase alternating current of 220 volts is delivered to the equipment from the power source by a line that is separate from the supply line for the shop machinery. There is also an individual transformer. Thus, with this manner of installation, the apparatus is absolutely independent of power fluctuations due to varying requirements in the shop.

X-Rays Lead to the Improvement of Castings

In addition to the use of this X-ray equipment for the 100 per cent inspection of welded boilers and drums, many studies are made of castings with a view to devising means for bettering them. On the table in the foreground of Fig. 1, there is a stainless steel casting ready to be analyzed by means of the X-ray equipment. Negatives made of this casting will show that it is sound or will disclose blow-holes, slag inclusion, or any other defects that may exist.

Complete studies of castings can be made by placing the films, assembled between wooden boards, in the different cored openings of the castings and then exposing them to X-rays. Three or four negatives can often be exposed at one time. In taking X-ray pictures of castings, a housing of heavy sheet lead is always built up completely around the work to prevent the escape of rays into the shop, and a similar sheet is used as a covering.

* * *

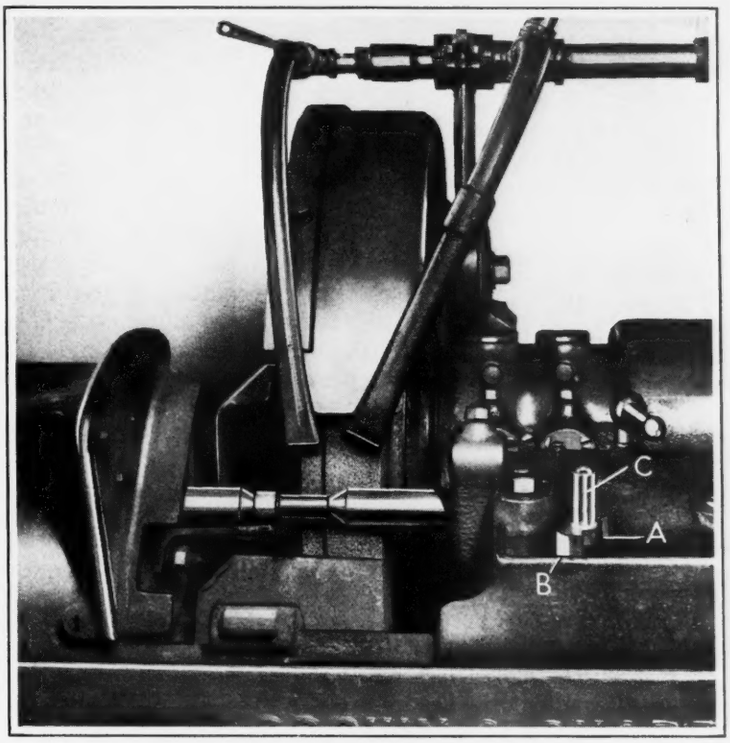
MAKING PRODUCTION ESTIMATES

In the plant of one well-known machine tool builder, when samples of rough castings or forgings are received from a customer to have a production estimate made, the procedure is as follows: First, a theoretical time study is made in the tool engineering department. Then this time study is checked in the shop by actual tests made by the tool equipment inspector. In this way, there is a double check, and if there is any appreciable difference between the results obtained in the theoretical time study and in the actual try-out in the shop, a careful investigation is made to determine the reason for this difference.

GRINDING TWO DIAMETERS AT ONE TIME

Hydraulic shock absorbers made by the Spicer Mfg. Co., Toledo, Ohio, contain a wing-shaft of the design shown at *A* in the accompanying illustration. In manufacturing this part, the outer peripheral surface *B* of the two wings and the shaft *C* are ground in one operation, although there is a difference of approximately 1 5/8 inches between the two diameters.

This operation is performed in grinding machines equipped, as illustrated, with two wheels dressed to different diameters. One face of the larger wheel is dished to permit the smaller wheel to project into the larger one a certain amount. This arrangement permits of grinding the shaft of the work close to the shoulder formed by the two wings. There is a clearance of approximately 1/8 inch between the two wheel faces.



Finishing Surfaces B and C of Wing-shaft A at the Same Time by the Use of Two Grinding Wheels Dressed to Different Diameters

The wing surfaces are ground to 2.561 inches within plus or minus 0.0003 inch, and the shaft is ground to a diameter of 0.925 inch within the same limits. Movement of the wheel-slide along the work is effected by means of hydraulic equipment, the wheel receding automatically from the work at the end of the operation. Reloading of the parts is facilitated by the air-operated tailstock center. The rate of production on this job averages 120 parts per hour.

* * *

MEETING OF THE TAYLOR SOCIETY

The annual meeting of the Taylor Society, with headquarters at 29 W. 39th St., New York City, was held December 3 to 5 at the Hotel Pennsylvania, New York. Among the subjects discussed were "Factors in the Elimination of Distribution Waste" and "The Maintenance of Standards in Industrial Work." "Technological Unemployment" was another particularly timely subject. A symposium "The New Challenge to Scientific Management" brought out an interesting discussion of the proposition that the problem of industrial stability requires that the principles of research, planning, and control, so successfully applied to individual plants, now be applied on a broader basis to industry as a whole.

Current Editorial Comment

In the Machine-building and Kindred Industries

THE SCIENTIST IN THE SHOP

Not many years ago, the idea of using X-ray equipment in a machine shop—particularly in a boiler shop—for the inspection of the equipment being built would have been considered utterly impossible. X-ray equipment was useful in the scientific laboratory and for medical purposes, but in the machine shop industry it had, as far as engineers at that time could see, no application.

But the picture has changed. Today we find X-ray equipment used for discovering defects in castings, forgings, and welds. MACHINERY has published several articles on the subject, describing how large pipe fittings and other castings are inspected by the penetrating X-ray. Now the application has been extended to the inspection of welds. A leading boiler manufacturer has equipped his shop with apparatus that renders quickly and definitely a verdict as to the reliability of fusion welds without the necessity of cutting test pieces or otherwise damaging the weld itself. The practice employed, as described in an article in this number of MACHINERY, will doubtless become more and more general during the next few years, and shop executives will find the new method well worth their attention.

Past differences of opinion between the theorist and the practical man are gradually being ironed out. The practical man has found that the scientist can render him a service obtainable in no other way. The scientist, in turn, has found a new field for his efforts in the everyday practical work of the shop. Instead of looking upon their respective interests as conflicting, the scientist and the practical man are now working hand in hand to accomplish ever greater results in engineering.

* * *

A CHALLENGE TO ENGINEERS

No one denies that the engineer has solved the problems of production so efficiently that if all the means that he has created for producing the things that the world wants and needs were properly employed, there would be an abundance for all. Following the leadership of the late Fred W. Taylor, he has also applied engineering methods to management and has shown that most management problems are susceptible of solution by engineering analysis.

At the annual meeting of the American Society of Mechanical Engineers, it was suggested that the methods that have been so successful in these fields should be applied to the problem of business stability. Ralph E. Flanders, manager of the Jones & Lamson Machine Co., in a masterly presentation of the problems still unsolved in the industrial field, stated the case briefly as follows: There are thousands of manufacturers eager to put idle plants into operation and there are millions of unemployed men anxious to go to work to produce the necessities and luxuries of life that they and the rest of the world want. In spite of this, at regularly occurring intervals, the industrial machine slows down and all but stops. The problem, according to Mr. Flanders, is in the field of economics and finance, but the economist and the financier have failed to solve it. It remains for the engineer to apply himself to this problem in the same way that he has attacked the problems of production and management. That the problem is incapable of solution is inconceivable—it is plainly a matter for the engineer to help solve.

Our production machinery is highly efficient when it is running; but of what value is efficient equipment when it stands idle? Just as the engineer has devoted his energy to reducing the idle moments in the operation of individual machines, so he is now asked to turn his attention to the problem of reducing the recurring idle intervals in the business cycle.

* * *

THE FOREMAN'S JOB ASSUMES NEW IMPORTANCE

The foreman of a manufacturing department is never in the limelight; yet upon him depends to a great extent the success of an industrial enterprise. He is the intermediary between the management and the workers. In this new industrial era his job is becoming constantly more important.

The successful foreman does not isolate himself in his department. He keeps in as close contact with the various activities of the company as conditions permit, and in this way, he becomes of greater value both to his employer and to himself.

His influence is felt in three directions. Upon him depends to a large extent the amount and the quality of the output of his department; he is able to influence costs to a marked degree; and his methods of dealing with the men in his department determine in a great measure the attitude of the workers toward the firm. If the men cooperate loyally, the foreman is generally the man who should receive credit. There is a tendency on the part of many foremen to minimize the significance of their job; it would be better for them and better for their employer if they would recognize the true importance of their work.

Checking Specifications to Prevent Errors

By RUDOLPH A. JOHNSON, Assistant Superintendent
Morgan Works, Wickwire Spencer Steel Co., Worcester, Mass.

MISTAKES in the specifications furnished a manufacturer by a customer, or errors in transmitting the specifications to the men in the shop, are often responsible for unpleasant misunderstandings, and occasionally result in considerable loss to both the manufacturer and the customer. When there is clearly a mistake in the specifications written by the customer, he has no one but himself to blame. However, the question as to whether or not the manufacturer has interpreted the specifications correctly sometimes arises, making it extremely difficult to place the blame where it rightly belongs.

The man who receives and checks a customer's specifications should make sure that he has all the information available regarding the job before he sends any orders to the shop. He should be thoroughly familiar with the methods employed in the shop and know what the workmen are capable of doing.

If any doubt exists as to whether his interpretations of the customer's orders and specifications are correct, he should have them verified before making out orders for the work to proceed in the shop. The orders sent to the shop should be in such form that they will be easily understood, and should be so prepared that there will be as little chance as possible of their being misunderstood.

The checker must have the proper mental attitude toward his job in order to enable him to concentrate easily and consistently on the work of checking and comparing specifications. He should acquire the habit of quickly forming a mental picture of the complete job, covering every detail from the time the need for the product becomes evident to the customer until the finished product is delivered. The instructions given in the following will help the checker avoid making costly mistakes:

1. Read the order carefully, and note all specifications and all references to supplementary specifications, such as quotations, correspondence, samples, parts, blueprints, and previous orders of a similar nature.

2. Check up drawings carefully and compare all details with the written order or instructions.

3. Eliminate all conflicting instructions after obtaining the necessary information.

4. Check each specification or dimension and its tolerance on each element or component of the specifications and check with each corresponding item on the drawing.

5. Trace any discrepancies and provide for the elimination of conflicting instructions.

The various sources of information that may be drawn upon in making corrections or in checking specifications are as follows:

1. Price estimate cards, samples, and blueprints furnished for price quotations, etc.

2. Samples accompanied by written orders for modifications.

3. Working parts with any operating instructions.

4. Customer's blueprints and sketches.

5. Customer's correspondence, including that of the sales and engineering departments.

6. Telephone conversations and memos regarding them, when available.

7. Verbal instructions or understandings between members of the organization and the customer.

8. Reports of members who have called upon the customer.

9. Records of complaints received from the customer.

10. Orders previously filled for the customer.

11. Rules governing trade customs, standards, and accepted practice.

12. Orders or quotations that have been given to or received from a branch office of the manufacturer.

Meeting of the Institute of Weights and Measures

The annual meeting of the American Institute of Weights and Measures was held at the main office of the Institute, 33 Rector St., New York City, December 2. The secretary, William E. Bullock, presented a complete report dealing with the aims and activities of the Institute, and with such related topics as the present status of metric legislation, current metric and anti-metric propaganda and arguments, difficulty of legal equivalents for converting customary into metric standards, comparison with the British metric situation, international standardization, new metric units, and various other topics on this general subject. The report also included a statement by Henry D. Sharpe, of the Brown & Sharpe Mfg. Co., concerning the importance of maintaining the identity of British and American standards. According to the Washington representative of the Institute, Mr. Cogswell, it is unlikely that Congress, during the present session, will consider the enactment of legislation favoring the metric system of weights and measures.

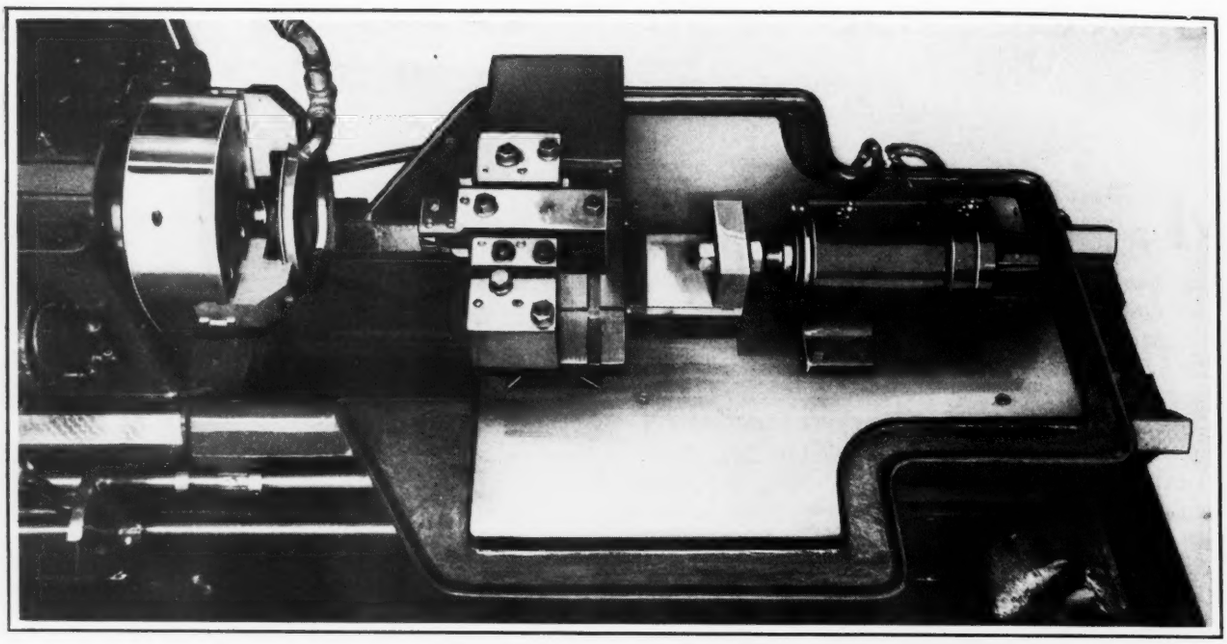


Fig. 1. First Operation on Ring Gear with All Tools on One Slide

Tooling an Automatic Lathe for Ring Gears

By I. F. YEOMAN, Foster Machine Co., Elkhart, Ind.

THE simple tooling arrangement illustrated in Fig. 1 is used in performing the first chucking operation on an automobile ring gear. The machine shown is a Fastermatic lathe of the platen type built by the Foster Machine Co. of Elkhart, Ind. On this operation, the floor-to-floor time for each piece is 1 minute.

With this set-up, both sides of the ring are faced, the hole is rough- and finish-bored, a chamfer is formed in one end of the bore, and one outside corner is rounded. All the tools are secured on one cross-slide, the cross-feed being automatically operated by a sliding plate cam. One end of this cam is attached to the ram of a hydraulic cylinder secured to the platen.

The feed required for boring is obtained by another hydraulic ram (not shown) which imparts a longitudinal movement to the platen. These rams are standard equipment on this machine, and all feeds obtained from them are automatically controlled by means of cams.

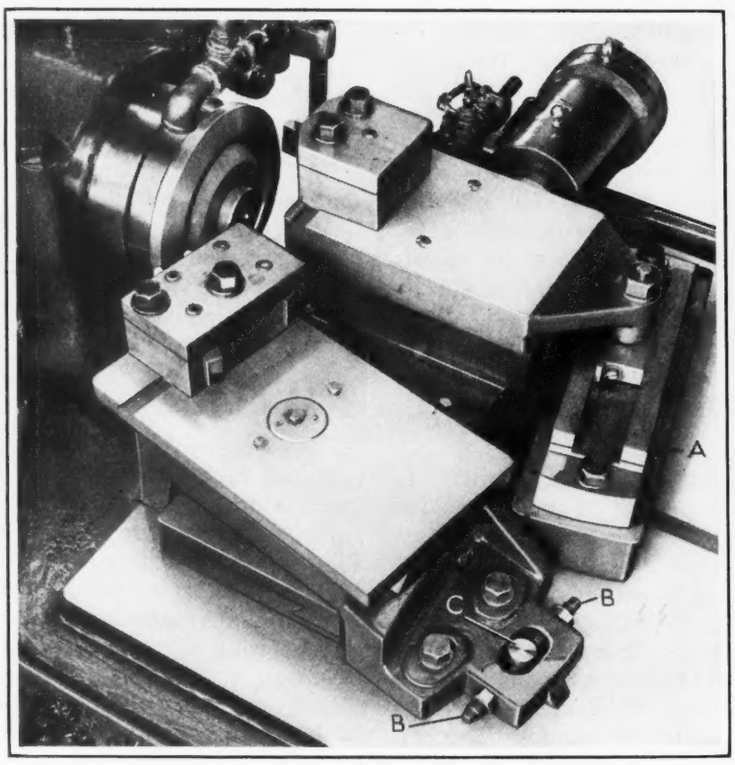


Fig. 2. Turning Two Tapers of Different Angles Simultaneously

In the second operation, shown in Fig. 2, a rather interesting example of compound bevel or taper turning is illustrated. The same type of machine is used in this case, although special tool-slides are employed and an air-operated adapter is used for holding the work. The operation on these gears consists of generating, simultaneously, two surfaces inclined at different angles, and boring the inside of the tooth ring. Two auxiliary tool-slides are used for obtaining the two tapers. Both slides are operated by one hydraulic cylinder at-

tached to the main cross-slide at the back of the lathe. The auxiliary slide nearest the cylinder is carried on the main cross-slide.

The taper generated by this auxiliary slide is controlled by means of the guide *A*, adjustment being provided so that the desired angle may be obtained. The taper generated by the other slide is much steeper; therefore, the angle is obtained by having this slide separate from the main cross-slide. It is carried on a bridge over the main cross-slide, and set to the desired angle by means of the screws *B* which act against the post *C*. A center stud projecting from the auxiliary slide engages a flat cam in the cross-slide and produces the required feeding movement. This flat cam imparts motion only, and has no effect on the directional movement of the angular travel of the slide.

In the plant where these ring gears are machined, it is the practice to rough-turn the complete lot of gears, after which they are rechucked and finish-turned all over with the equipment shown in the illustrations.

The White Motor Bonus System for Tool-room Work

It is frequently contended that while bonus systems are ideally suited to production work, it is not feasible to apply such a plan of payment to the work of the toolmaker. There are, however, at the present time a number of well-known manufacturing plants that operate their tool-rooms on a bonus plan. One of these is the White Motor Co., where a bonus plan has been applied to the work of the tool-room for several years.

It is necessary, of course, in applying the bonus plan to tool-room work to establish certain standards and to make up a table or chart of carefully computed time studies covering elementary operations on each group of machines in the tool-room of similar type and capacity.

These elementary standards are then grouped into what are called "Series Operation Standards"; in other words, the elementary movements that must be performed to complete a frequently recurring operation are grouped together, as, for example, "Mount Vise on Milling Machine Table and Prepare for Loading," or "Change Lathe from Center Set-up to Chuck Set-up."

The series operation standards are next grouped together and totaled for a given job in order to obtain the time required to complete the work on a given tool. By these elementary time studies and by the grouping together into more complete frequently recurring operations, it is possible to determine quite rapidly the time that it should take to perform the operations required in tool-room work. Time studies have also been made for the rate of removal of metal, and charts are provided for each grade of material and machining condition.

A copy of all the sets of standards is placed in the tool-room and is accessible to the workmen for use in checking up any bonus figures that they may believe to be in error. The bench work was also brought under the bonus plan by establishing a ratio of bench standard hours to machine standard hours. This ratio was established by very careful time studies extending over a period of months. It was found that this ratio remained fairly constant if tallied over as long a period as two weeks. The men working at the bench are placed on a group bonus, and their efficiency is calculated twice a month—that is, for each pay period.

Since the bonus was first introduced, in January, 1925, it has been found possible to reduce the tool-room force by approximately forty-five per cent. Available records indicate that about the same volume of work is passing through the tool-room in spite of this reduction in the force. The earnings of the toolmakers have increased approximately twenty-eight per cent under this plan. Three men are employed in making the calculations required for the operation of the bonus plan for a tool-room employing between forty and fifty men.

* * *

ELIMINATING LOST MOTION IN GEAR TEETH

By C. G. WILLIAMS, Chief Engineer
Green Bay Barker Machine & Tool Works, Green Bay, Wis.

Although the device described on page 95 of October MACHINERY for eliminating lost motion in gear teeth has been used with fair success, the writer can see no advantage in using an extra gear for this purpose. Such an arrangement entails extra cost in fitting and selecting springs that will exert a tension exactly equal to the force required to operate the machine. If the spring tension and the force are not balanced in this way, back motion will occur, although no chatter will be heard.

This arrangement was employed on several machines in one plant by applying the spring tension to gears 1/32 inch thick which were made of carbon steel and hardened. When it became necessary to repair these machines, the writer replaced the tension gear type of drive with four narrow helical gears which were pinned together in pairs to produce gears of the herringbone type. The latter arrangement gave much smoother operation than the former drive, which consisted of one wide gear and two thin gears subjected to spring tension.

* * *

In some places where lineshafting is still in use, and machines, particularly power presses, are belted to pulleys on the lineshaft without the use of a countershaft, a double hook made of 1/2-inch round iron, should be provided for each pulley to catch the belt when it is thrown off and prevent it from riding on the rotating lineshaft.

Notes and Comment on Engineering Topics

The six principal hydro-electric generating stations at Niagara Falls now produce over 1,600,000 horsepower. Thirty-five years ago, the generators used in the first Niagara Falls power plant, which were considered marvels in their day, were capable of generating 5000 horsepower. Today, the generating units are ten times this size, or more.

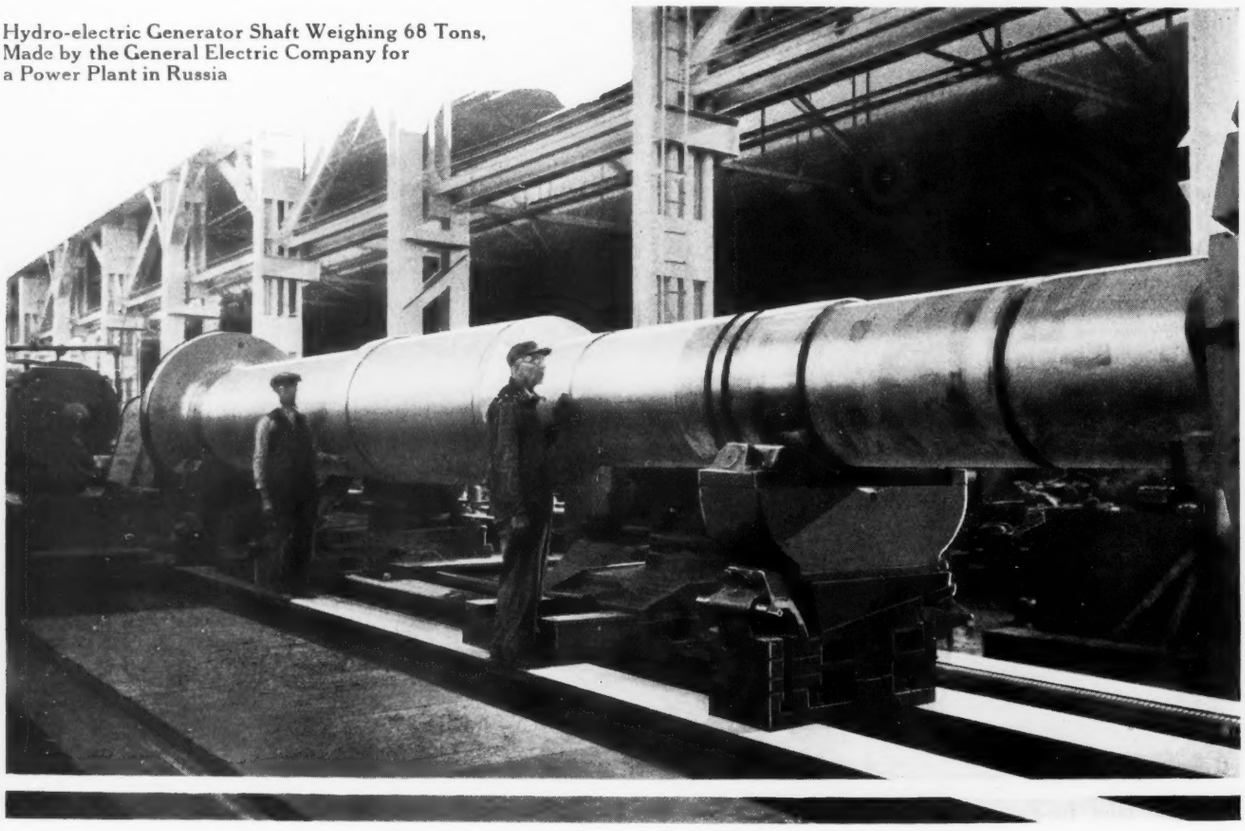
The illustration below shows the world's largest hydro-electric generator shaft during the process of machining at the Schenectady Works of the General Electric Co. This immense one-piece steel forging weighs 136,000 pounds and has a length of over 36 feet. This shaft will transmit 84,000 horsepower and will carry a vertical load of 1000 tons. The coupling shown at the left end of the shaft is nearly 6 feet in diameter. To this coupling the hydraulic turbine will be attached by means of a shorter shaft. The thrust bearing collar will be mounted on the right or top end of the shaft. The machine for which it will be used is to be shipped for installation in the Soviet Republic, where several very large hydro-electric power plants are being equipped with American machinery.

The photo-electric cell has now been applied in a paper mill to give a signal when there is a break in the paper during its manufacture. By having a source of light on one side of the sheet and a photo-electric cell and other operating equipment on the other side, the instant there is a break in the paper, the light rays pass to the cell and operate a relay which, in turn, sounds a gong and also graphically records the break.

The size of the combustion chambers of large steam boilers now being built may be judged from the fact that the Pacific Northwest Public Service Corporation recently entertained forty-nine guests at a dinner served at tables placed in the combustion chamber of a 2650-horsepower boiler.

Insulated aluminum wires and cables for electrical purposes are now available under the trade name "Alectral." Such wires and cables are made by the General Cable Corporation. Heretofore, practically all the aluminum used in the transmission of electrical energy has been in the form of bare conductors. Within the last ten years more than 250,000,000 pounds of aluminum have been used for overhead transmission lines. The new development will enable the electrical engineer to employ aluminum in a much broader field.

Hydro-electric Generator Shaft Weighing 68 Tons, Made by the General Electric Company for a Power Plant in Russia



Zinc and Cadmium for Preventing Corrosion

A Comparison of the Fields of Application of Two of the Most Valuable Metals Used for Protecting Other Metals from Corrosion

By L. K. WRIGHT, Consulting Engineer

CORROSION is one of the most serious conditions with which executives of manufacturing plants and industrial concerns have to contend, and the old saying, "Most apparatus will rust to pieces before it wears out," continues to hold true in many instances. There is much controversy as to which is the most efficient medium for preventing corrosion. Among the various methods used may be mentioned the application of oil to the surface to be protected, various methods of varnishing and painting, and the application of a metallic layer or skin to the surface. The metallic layer may be applied either by immersing the article in a bath of molten metal—such as lead, tin, or zinc—or by the electro-deposition of the metallic film.

Coatings or films, to be of value, must provide the surface to be protected, or the "base," with an impervious layer, completely covering and isolating it from all outside influences, so that the base—which, in the present article, is assumed to consist of iron or steel—has no possible chance to undergo the chemical change, the result of which is familiarly known as "rust." Rust destroys millions of dollars' worth of steel parts every year.

Zinc and Cadmium as Protective Coatings

Of all the materials employed to combat rust, zinc and cadmium are probably the most effective. Chromium, like nickel and copper, while highly resistant to atmospheric action, does not offer protection to an underlying metal. In electro-chemical protection, chromium, nickel, and copper are entirely unlike zinc and cadmium, because the former metals tend to induce corrosion, while the latter protect.

The chemical behavior of cadmium is similar to that of zinc, except that the former is not quite so readily attacked by acids or alkalies. The softness, malleability, and ductility of cadmium make it superior to zinc, because knocks or blows, which would cause a zinc coating to break away or flake off from the plated object, have little effect on a similar deposit of pure cadmium.

A Comparison of the Value of the Two Metals as Protective Agents

In the United States Army Specifications No. 3-100-A, issued February 15, 1927, and covering "Coatings, Protective, and Finishes for Aircraft Accessories," Section 5, it will be found that a thickness of 0.0003 inch of cadmium is considered equivalent to a thickness of 0.001 inch of zinc; in other words, the zinc coating, to have the same resistivity as the cadmium film, must be about three and one-half times as thick.

On this basis, it will be found that where 0.0035 inch of zinc is required, the weight of metal will average about 2.05 ounces per square foot; whereas only 0.71 ounce per square foot of cadmium is required to offer the same protection. While this is extremely important where light weight is paramount, the thing to consider in ordinary applications is comparative costs.

Cadmium, at the present time, costs from ten to twelve times as much as zinc; thus, about 0.0408 cents worth of cadmium against 0.0089 cents for zinc would be required for equivalent protective coatings. Roughly, therefore, it may be said that cadmium plating is about four times as expensive as zinc plating for a metal thickness of equal protective value.

One advantage of cadmium plate is that, for the same current strength, about 40 per cent more cadmium than zinc can be deposited per ampere hour. Thus the plating time is considerably less for cadmium, as a tank of cadmium solution will finish more work than a zinc plating bath in the same time and at the same expense. The saving in time, space, and equipment is thus greatly in favor of cadmium.

How to Decide upon which Metal to Use

The conditions to which the plated articles are to be subjected should form the basis of selection when the greatest resistivity is desired, and then the price should be considered. To decide which metal of the two considered better meets the problem, a chart should be prepared listing the article to be plated, the changes in design that may be required to make it suitable for plating with either metal under consideration, the cost of cleaning and preparing, the cost of the metal used, the cost of the current and of finishing, and the cost and time of the electro-deposition itself.

Each metal has its own particular advocates who often overlook many admirable qualities in the other metal. However, there is no single metal that meets all needs. Sometimes a cheap metal will outlast a more expensive one, and sometimes the expensive one will be the only metal that will provide satisfactory resistance. The best coating for any particular case, therefore, must be ascertained by experiment and by the recording of conclusive data. Do not guess or trust to personal pet notions; establish the proofs first, and then decide accordingly.

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

IN November MACHINERY, page 186, an important subject is touched upon in the article on trained operators. In our shop, production from a new machine tool was unsatisfactory because of our lack of information on the correct tooling and operation of the machine. After sending a foreman to a plant having similar equipment, to obtain information, we were able to get the proper results.

In the Navy, it is the general practice each year to send a selected group of mechanics to the industrial concerns from which the Navy purchases equipment. These men receive instruction on the operation and care of the machines that have been bought. They return to the service as instructors of the rest of the personnel, either at the service trade schools or in the shops.

To some extent this is done by industrial concerns as well, but it could be done to an even greater extent with beneficial results. As far as the writer knows, machine tool builders are more than willing to give such instruction in their shops.

CHARLES H. WILLEY

OPERATING A SHOP DURING A DEPRESSION

The editorial on page 258, December MACHINERY, outlining a plan for keeping men employed during a period of depression, illustrates a fact that has impressed the writer very strongly during the past year. There has never been a period of depression when manufacturers have tried as hard as they are doing now to keep as many men as possible employed, even though the working hours have to be reduced materially. The idea of working half the force every other week appears to be a new one. In most instances, the scheme has been to operate the plant three or four days a week. In one case, the plant has been operated forenoons throughout the week, and shut down during the afternoon.

Manufacturers recognize more than ever that it is not only humane, but also good business to keep as many men as possible employed, because the fewer the number of unemployed, the less severe will the effects of the depression be on industry as a whole. During the present depression, several manufacturers that are financially able to do so have extended aid to those of their employes for whom they were unable to find work of any kind. The unemployment insurance plan of the General Electric Co. has been given much publicity and is now well known throughout the industrial field, but in other instances employers are known to have extended financial aid to their employes on the basis of making loans, which will be gradually repaid from the men's earnings when active business once more returns.

Meanwhile, the problem of getting at the causes of these periodic depressions is being attacked. One of the most hopeful signs at the present time is the interest shown in this subject. The American Society of Mechanical Engineers has begun to take an active interest in the unemployment problem and in the stabilization of industrial activity. The other national engineering societies will doubtless take steps in the same direction. If the interest of the engineering and industrial field can be thoroughly aroused, there is no doubt that the severe fluctuations of the business cycle can be ironed out.

OBSERVER

SHOULD THE FOREMAN DO THE TRAINING?

I do not believe that the foreman should train either operators or apprentices. He has his specific duties to perform in getting out production and maintaining quality. If he does this faithfully, he has no time for training apprentices. Furthermore, the foreman must have certain executive qualities, but he is not expected to be trained in the art of teaching; and successful teaching certainly is an art all by itself.

This is an age of specialists and we should not go back to older practices after such rapid strides have been made in new teaching methods. The apprentice or the operator should not be trained by a man whose ideas may be rather specialized, but by a man competent and experienced in teaching shop work.

CHARLES R. WHITEHOUSE

WHAT ABOUT VERBAL ORDERS?

Any proposition that has so many arguments in its favor as the question of written orders is almost bound to defeat itself in practice, because it will be carried to extremes. Many orders cannot be given in writing, from a practical viewpoint, any more than they could be given by a phonograph record—they require discussion and questions and answers for their proper transmittal. Emergency and rush orders must, by necessity, be essentially verbal; likewise, those dealing with development and experimental work depend to a great extent upon word of mouth. Some of the best ideas are born in friendly arguments over the interpretation

of orders. You cannot argue with a written order as graciously as you can with a verbal one. The proper answer is a practical compromise: Use both methods—each has its place. LEWIS J. YAPP

WHICH EMPLOYES SHOULD BE KEPT IN A DEPRESSION?

As a general rule, to what extent should an employer take into consideration the personal affairs of the individual employe? The modern shop is theoretically a machine. The more nearly perfect its component parts are—including labor—the more perfectly will it operate. Granting this, it must be the aim of the management to obtain and retain the very best labor obtainable. Unless this is done, the plant cannot function on a thoroughly sound, economic basis, and its financial position cannot be at its best.

When business ebbs, as at the present time, the shop must function with a reduced output and a correspondingly reduced staff. Who must go first? Is it the man without dependents, the man with a little laid by, the student who may have a home to go to; or is it the man who is of the least value to the company—the most inefficient part of the mechanism?

From the efficiency standpoint it must be the latter, quite apart from the consideration whether he is able to weather the bad spell or not. At first sight, this appears a harsh move, but from sound, economic operating considerations, which provide his one chance of renewed employment, he must go now. Is it not erroneous charity to keep him? Someone once said, "When the heart and reason come into conflict, the heart is always wrong."

On the other hand, by following the charitable side, a pleasanter feeling may be created and a more cordial atmosphere will exist for the time being; but this is offset by the less satisfactory operation of the shop.

It is to be hoped that questions such as this will not arise in the future, for business must and can evidently be so arranged that the present business cycles will be smoothed out to a great extent. Until then, however, I believe that reason must guide in solving this unfortunate problem. F. N. S.

BUYING FOR TRADE SCHOOLS

Shop executives will be interested to learn that it is the practice, in some cities at least, to buy the very cheapest shop equipment obtainable for the public trade schools. Is it likely that the best kind of mechanics can be trained in schools using equipment that does not even measure up to the specifications of the men in charge of the training? Will not industry as a whole ultimately suffer from this practice?

The writer was told recently that the board purchasing equipment for the schools in one of the large industrial cities in the East completely ignored the specifications that had accompanied the requests for bids. A member of the board told one of the competing manufacturers that the board frequently rejected all bids and then bought whatever was obtainable at the lowest market price.

If it is worth while spending large sums of money on building trade schools and maintaining a trained staff of instructors, it ought to be worth while to spend an adequate amount on installing at least a fairly good quality of equipment in the shops, so that the boys would not become accustomed to the unsatisfactory work that can be obtained from inferior grades of machines. At least, when specifications accompany requests for bids, machinery that meets the specifications should be installed.

O. G.

THE WORK OF THE SALVAGE COMMITTEE

In the shop where I am employed there is a salvage committee composed of three men, one from the engineering bureau, one from the shop, and one from the purchasing department. This committee looks over all obsolete material and spoiled work at regular intervals and determines whether some of the material may be used for another purpose, either in its present form or by reworking, as, for example, by cutting down a piece to a smaller size.

In this way, a great deal of waste of material may be prevented. In one case a draftsman made the over-all length of the hub of a small pulley about 1/2 inch too long. Two hundred pulleys were ordered. When the error was discovered, just previous to assembling, it was immediately taken up by the salvage committee. After studying the situation, they concluded that the excess material could be cut off and used as a collar at the end of the shaft on the same type of machines as those for which the pulley had been designed.

Salvage work is greatly neglected in most shops. It would be possible to save a great deal of material if more attention were given to the salvaging of spoiled work. GEORGE A. FRIES

BUYING ON SPECIFICATION

In writing a specification, it is not always possible to insert all the "shall not" clauses required to guard against unsuitable material being supplied. Reputable manufacturers constantly seek to improve their product and to make it even better than required by the specifications, but there is always a small group of manufacturers who will try to reduce costs to a minimum within the terms specified. The purchaser must guard against products manufactured in this way.

A first bid from a well-known manufacturer may be accepted with assurance; but when a low bid comes in from an unknown concern, the purchaser should request samples and have them checked before awarding the contract. Satisfactory experience with a product in the past should be the deciding factor in buying supplies if the price differential is small. HARRY KAUFMAN

DEVICES FOR BABBITTING BEARINGS

By J. DWIGHT LLOYD

Several devices employed in babbitting bearings are shown in the accompanying illustrations. In Fig. 1 is shown a simple method for checking the alignment and amount of wear on a bearing. The gage *A* is made of sheet steel 1/8 inch in thickness. The legs rest on the housing of the bearing and the anvil clears the shaft by 0.001 inch. On high-grade machinery one gage of this kind will generally suffice for all bearings of the same size. If a bearing has become worn an appreciable amount, the shaft will ride lower in the bearing and the difference in the clearance can be easily detected.

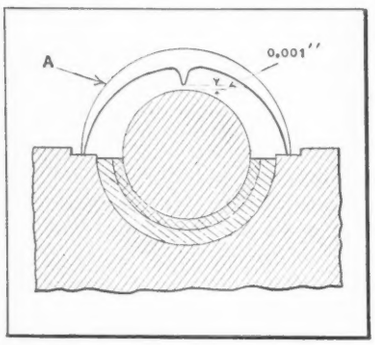


Fig. 1. Gage for Checking Bearing Wear

In Fig. 2 is shown a simple jig used in babbitting bearings. It is made principally of wood. The base *A* is a plank 10 inches wide, 3 feet long, and 1 1/2 inches thick. This plank should be of sufficient size to accommodate the largest bearing to be babbitted. The size is naturally determined by the range of bearing sizes found in the plant in which the jig is to be used. Blocks *B*, which are 1 inch high, are secured to each end of the board to serve as feet.

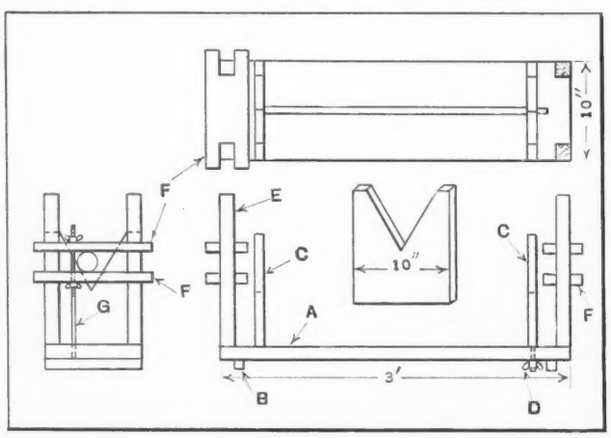


Fig. 2. Jig Used in Babbitting Bearings

The wooden pieces *C* are 1 inch thick, 10 inches wide, and have a large V-shaped notch at the upper end. One of these pieces is fastened securely to the base *A* near the left-hand end, while the other is held in place by a bolt and thumb-nut *D*. The bolt passes through a slot cut lengthwise of the base, so that the block *C* can be moved along the base and clamped in the proper position for supporting bearings of different lengths.

At each corner of the base are fastened upright posts *E*. These posts serve as guides for the clamping members *F*. A bolt *G*, 1/2 inch in diameter, which has a long threaded portion and is provided with two thumb- or wing-nuts, is used to hold the arbor in place.

In babbitting a bearing, the shell or bearing member is supported by the V-notches in pieces *C*. The arbor that rests on the lower clamps *F* is located in the right position to give the required thickness of bearing metal by adjusting the wing-nuts on bolts *G*. The arbor is held securely in place by means of the clamps *F* while the babbitt metal is being poured.

In Fig. 3 are shown diagrammatically two good arrangements for use in pouring babbitt metal in removable shells. At the left are shown two views of the arrangement used in pouring the metal in half-bearing shells, while the two views at the right show elevation and end views of the arrangement used for pouring the metal into the two half shells at one time.

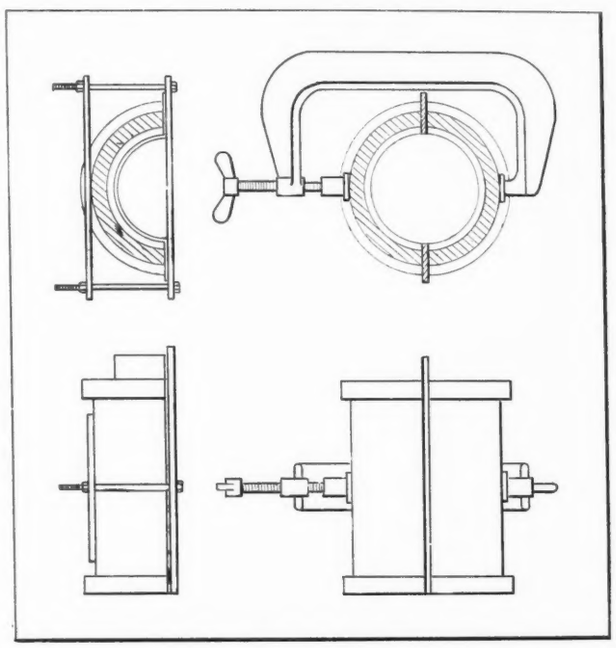


Fig. 3. Arrangements Used in Pouring Babbitt for Liners of Removable Shells

Fig. 4 shows two boards cut to fit the shaft and held together by stay-rods while the babbitt metal which forms the lower half of the bearing is being poured. In making use of this arrangement, care should be taken to see that the shell is spaced evenly around the shaft. The various kinks described in the foregoing have been suggested through the courtesy of the Magnolia Metal Co.

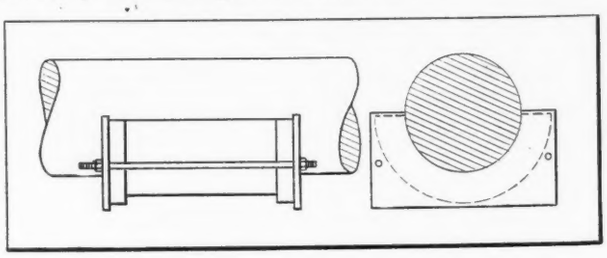


Fig. 4. Mold for Bearing that is to be Babbitted with the Shaft in Place

Design of a High-speed Assembling Machine

Constructional Features of a Machine that Assembles Electrical Resistor Units at the Rate of 250 per Minute

By CHARLES O. HERB

RESISTOR units comprising the four parts illustrated in Fig. 1 are made in enormous quantities by the Allen-Bradley Co., Milwaukee, Wis., for use in electrical equipment. The four parts of these "Bradley units," as the resistors are called, include a bakelite rod or pin 1/4 inch in diameter by 1 5/8 inches long, an insulating paper sleeve 1 1/4 inches long, and two small steel stampings which have a 1/16-inch hole in the closed end. The machine to be described in this article forces the stampings or caps on the pins at the rate of 250 complete units per minute, which is equivalent to more than four per second. The paper sleeves are placed on the pins previous to this assembly.

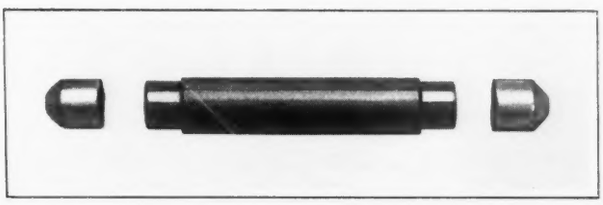


Fig. 1. Bakelite Pin with its Paper Sleeve and Two Steel Caps which are Assembled by the Machine Shown in Fig. 2

The assembling of the caps on the bakelite pins is accomplished by two series of slowly revolving spindles *A*, Fig. 2, which are carried around a circular path by the large drum on which they are mounted. As the two groups of spindles travel around their circular paths, they come in contact with the edges of the cams *D*, which gradually force the spindles toward the center of the machine, the spindles on the left-hand side being moved toward the right, and those on the right-hand side, toward the left. Spindles *A* coincide with grooves cut across plates *B* to which the pins and caps are fed automatically. Thus, as the drum revolves and the opposing spindles advance toward each other, the caps are forced on the bakelite pins. The assembled pins drop into a tote-box at the bottom of the drum rotation.

Each spindle is held in a shaft member which has a spur pinion *C* at the rear end. These pinions

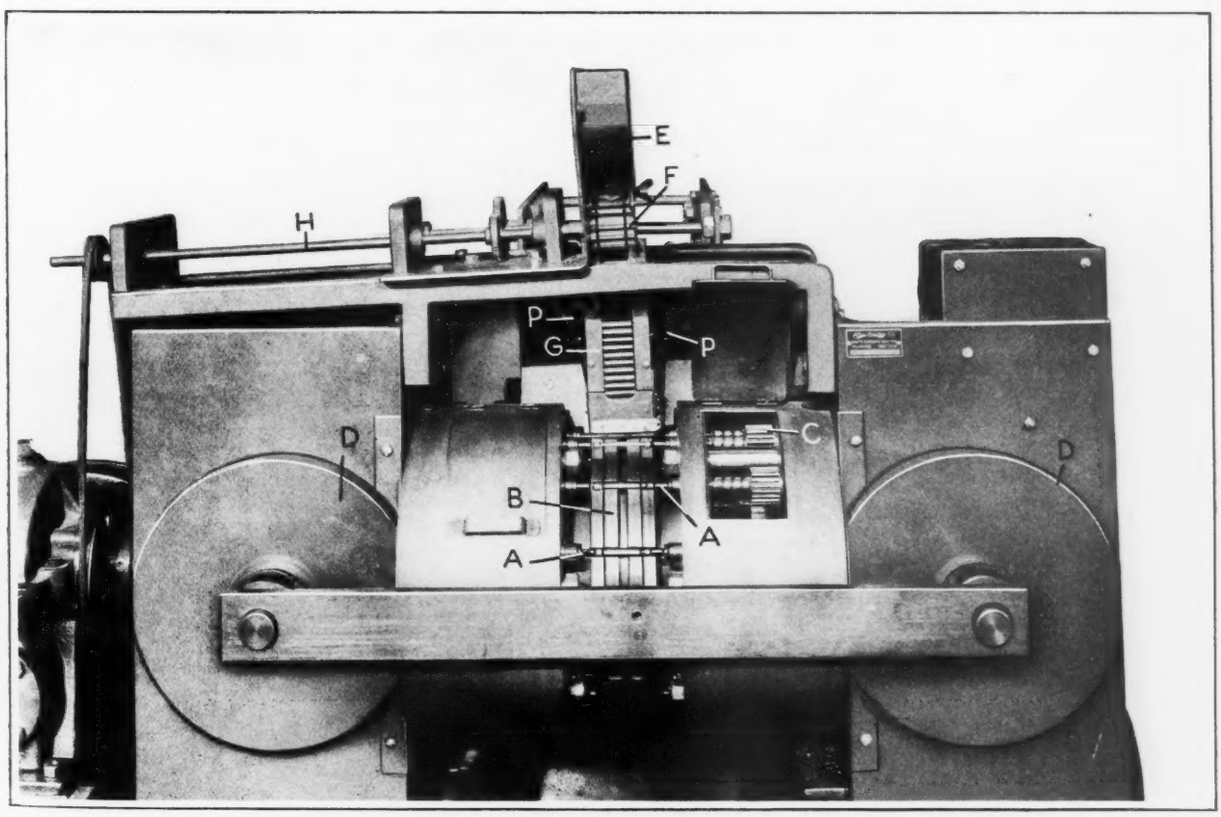


Fig. 2. Front View of the Machine, Showing the Assembly Drum and the Horizontal Spindles which Force the Caps on the Bakelite Pins

mesh with a large stationary gear, and as a result, the spindles revolve on their own axes in the course of their movement around the drum. The slow rotation of the spindles assists in forcing the caps on the pins. Wide faces are provided for the pinions because they move horizontally with the spindles.

Power for driving the drum unit is delivered direct to the shaft on which the drum is mounted from the main source of power. This consists of a gear reduction unit and a small motor, which are attached to the machine on the left-hand side.

How the Pins are Fed to the Assembly Drum

The bakelite pins, with the paper sleeves on them, are placed in hopper *E* at the top of the machine in the manner illustrated in Fig. 3, which shows this hopper with one side plate removed. Two grooved wheels *F* at the bottom of the hopper revolve slowly and allow the pins to drop one by one into chute *G*, which leads to the assembly drum. The lowest pin in the chute rides on plates *B*, Fig. 2, until it reaches a groove, when it falls into the groove and is carried forward by the drum to have the caps assembled to it.

The right-hand wheel *F*, Fig. 3, rotates clockwise and the left-hand wheel counter-clockwise. This tends to push the pins upward and prevent them from wedging between the rolls. The grooves in the rolls form openings through which only one pin can fall at a time into the chute. Power for driving wheels *F* is taken from the driven shaft of the gear reduction unit and delivered through pulleys and a round belt to the overhead shaft *H*, Fig. 2, on which one of the wheels is mounted. Gears near the front end of this shaft transmit the drive to the second grooved wheel, which is revolved in the opposite direction.

Unique Means Employed to Bring the Caps to the Assembly Drum

Considerable ingenuity was required to devise a means for feeding the small caps to the assembly drum at the proper rate and with the open ends pointing toward the bakelite pins on which they are pressed. A bin *J*, Fig. 4, has been provided at the back of the machine into which the caps are dumped as they come from the punch press. A slowly rotating drum *K* on which there are a number of hooks *L* extends into this bin, and as the hooks are pointed at right angles to the drum axis while in the bin, they catch the caps on their outer conical points. The drum revolves upward as viewed in Fig. 4.

As hooks *L* approach the upper point of the drum rotation, cams within the machine cause the hooks to swivel gradually until their points are parallel to the drum axis. When this occurs, the caps tend to fall from the hooks but are held in place by cams *M*. The hooks carry the caps forward until spring-actuated fingers *N*, Fig. 3, are reached. These fingers, which are provided on each side of the machine, pull the caps from the hooks and hold them until the next caps reach the fingers, when the preceding ones are forced into guides *O*.

Thus the caps are forced along the two guides and into two chutes *P* which lead down to plates *B*,

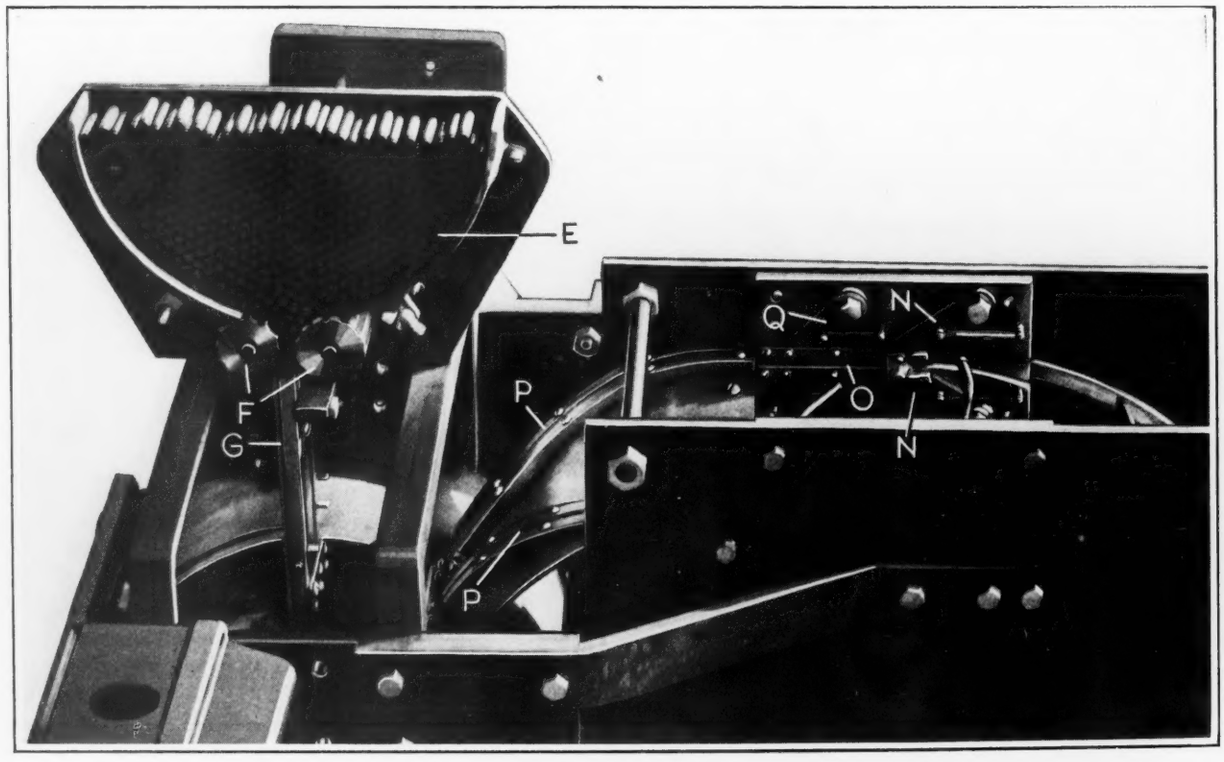


Fig. 3. View of the Pin Hopper and of the Chutes that Feed the Pins and Caps to the Assembly Drum

Fig. 1, of the assembly drum. From chutes *P*, the caps fall into the two outer plates of group *B*. One end of the spring-controlled finger *Q*, Fig. 3, extends into each guide *O* to prevent the caps from advancing into the corresponding chute too rapidly.

Drum *K*, Fig. 4, is driven slightly faster than would be required if every hook *L* picked up a cap each time it passed through the bin, but it often happens that the hooks do not pick up caps. Thus, to insure that there will always be a sufficient quantity of caps in chutes *P*, Fig. 3, to meet the assembly requirements, the drum is driven at a rate that would sometimes result in the caps reaching the chutes too fast, causing jamming of the machine, unless means were provided for avoiding this condition.

When either pair of chutes *P* and guides *O* becomes too full of caps, so that considerable pressure is required to force another cap between the corresponding set of spring fingers *N*, a slip clutch on the shaft of drum *K*, Fig. 4, is released, and the drum remains stationary until the caps have advanced along the guide and the pressure has been reduced. Drum *K* is actuated by the main drive shaft of the machine, through sprockets and a chain, as shown.

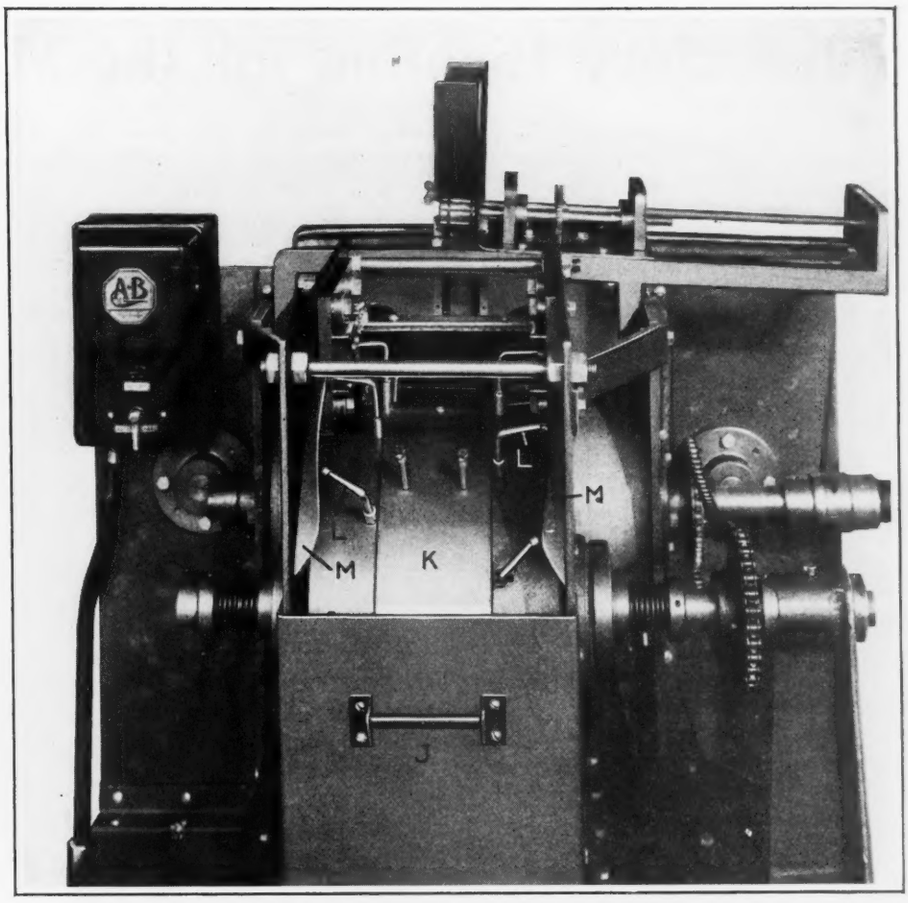


Fig. 4. Rear View of the Machine, Showing Drum K, which has Hooks L that Carry the Caps to Chutes Leading to the Assembly Drum

* * *

A NEW WELDING PROCESS

A new method of oxy-acetylene welding, known as the Lindeweld process, has been introduced by the Linde Air Products Co., 30 E. 42nd St., New York City. This process is the result of years of laboratory research and field testing. It depends essentially on a new method of blowpipe manipulation and the use of a new welding rod, introduced for that purpose, known as "Oxweld No. 24 Lindeweld process welding rod."

It is claimed that in welding pipe for oil and gas lines, the new process has saved from 30 to 60 per cent of the time required to make the welds by methods previously employed, and that the oxygen and acetylene consumption has been considerably reduced. At the same time, consistently stronger welds have been obtained. More than 300 miles of high-pressure pipe lines have been welded by this process up to the present time.

CLEVELAND AIDS INVENTORS

Through a new service established by the Industrial Development Department of the Chamber of Commerce of Cleveland, Ohio, inventors are to be aided in having their developments brought to the attention of leading manufacturers. Inventors may submit descriptions of their inventions to the Chamber of Commerce; the inventions are then listed in a letter that is sent to more than 2000 manufacturers. If a patent has not been applied for, it is suggested that inventors protect themselves by filing away a duly witnessed copy of their inventions, in addition to sending a copy to be filed by the Chamber of Commerce.

Several hundred inventors and engineers have already taken advantage of the plan and several are now negotiating with Cleveland manufacturers. Those taking advantage of this service are urged to submit full details with the first communication, addressing it to the Industrial Development Department, Cleveland Chamber of Commerce, 1704 Terminal Tower, Cleveland, Ohio.

* * *

It is dangerous practice to leave pieces of round shafting or bolt ends lying around the shop floor, where they may be stepped on, as serious injury may result from slipping or skidding on such objects.

Satisfactory Lighting for the Machine Shop

Good artificial light is of great importance in the machine shop. Experience has shown that in a well lighted shop it is easier to obtain not only a higher quality of work, but also a greater output.

Proper shop lighting should be studied carefully by qualified engineers and installed in accordance with their recommendations.

The shop to the left was photographed with no other lighting than that from the electric lamps. The photograph was reproduced without retouching. Note evenly diffused light.

It is not enough to provide sufficient candlepower in planning the lighting of a shop. A bare lamp over a machine, as shown to the left, is likely to prove a menace rather than a help to the worker.

The illustration to the right shows a good system of overhead lighting, with the lights properly spaced to provide evenly distributed illumination.

Tolerances for Maximum Reamer Service

By WALTER G. HOLMES

THE following comments on the standardization of hole tolerances and reamer and plug gage sizes, prompted by the article in August MACHINERY, page 961, may prove of interest. The system, as outlined in the article referred to, is based on the premise that the average reamer cuts 0.0005 inch over size. The important factor in this case, however, is not the average but the maximum amount that the reamer cuts over size; and hence, the most dependable basis of standardization for a system of tolerances for cylindrical holes is the maximum amount that the reamer cuts over size.

Reamers are Likely to Cut as Much as 0.001 Inch Over Size

A 1/2-inch diameter rose reamer will cut as much as 0.001 inch over size, or even more, unless the conditions of its use are unusually favorable. For a large class of work, this is entirely satisfactory; and when it can be done, it makes for economy in tool maintenance and in machine and fixture upkeep to allow this tolerance. A system that requires a new reamer to cut no more than 0.0005 inch over size, if employed on the same class of work, will increase the expense for maintaining an accuracy in the reamers, bushings, and machines that is not warranted for the average job.

A new nominal 1/2-inch rose reamer used for a production job, reaming holes to limits set by Class 4 tolerance, will not actually produce holes with a tolerance of 0.0015 inch, as the new reamer has a maximum diameter of 0.5000 inch and the minimum hole size is 0.4990 inch. As the reamer cannot cut under size, the difference between the maximum reamer size of 0.5000 inch and the minimum hole size of 0.4990 inch cannot be used effectively in manufacturing work; and the condition of Class 6 tolerance, where 0.0005 inch over-size cutting is allowed, will be the actual working conditions for a new reamer which was supposed to produce holes with a tolerance of 0.0015 inch of Class 4.

The results obtained are even more marked when holes in Class 1 are produced, as here the minimum hole size could be 0.4965 inch, but the reamer is 0.5000 inch in diameter and cannot cut under size; so a tolerance of 0.0005 inch is the only possible tolerance for a new reamer in any class in the tolerance system described in August MACHINERY. Based on this reasoning, the writer claims that a hole tolerance system, where the variable is the minimum limit only, cannot be truly in accord with average working conditions.

Large Reamers will Cut a Greater Amount Over Size

A comparison of the smallest and largest sizes of the standardized reamers leads to the following conclusions: A 1/8-inch reamer is not strong enough to keep exactly in line with the spindle travel, but will, to a great extent, follow the drilled hole, which means that it will cut very close to size; a 1 1/2-inch reamer will have a tendency to follow more nearly its own path through the hole, as the tool will not bend readily under the working stress and will, therefore, cut a greater amount over size.

On high production jobs, where cast iron is reamed, using no cooling solution on the tool, there is a tendency for the reamer to become heated. This may cause it to become from 0.0002 to 0.0004 inch over size, depending upon its diameter. This is a variable factor which cannot be taken care of in a standardization system covering all uses of reamers.

Rose reamers may be used on free-working steel when a flood of lubricant is employed and the alignment is kept in good condition. In that case, the reamer will cut holes within close limits, but the exact amount that it will cut over size will depend upon the condition of the reamer, the method of use, and its diameter. The reamer will maintain its diameter for a long time and will become dull and require sharpening on the cutting end only. On all other materials, a rose reamer will bind on the cylindrical lands while cutting. This will rapidly wear down its diameter and destroy its usefulness. On soft, tenacious materials it cannot be used successfully. The wear will leave the cylindrical lands in a poor condition, and the outside diameter must be reduced until a true cylinder is formed, in order to put them back in good condition. This will remove from 0.002 to 0.006 inch from the diameter; it will destroy practically all the salvage value if the reamers are expected to be used in different classes varying by steps of 0.001 inch.

How the System Proposed will Work in Practice

The standardization system outlined in the former article in MACHINERY proposes to use a new reamer for Class 6 holes, and when it becomes worn, so that it cannot produce holes to the close tolerance of 0.0005 inch, the reamer is to be used for Class 5 holes having a tolerance of 0.001 inch. The writer gathers from the article that the premise of the standardization is that reamers cut 0.0005 inch over size, and that being the case, we still have the condition that the reamer produces holes that vary a maximum of 0.0005 inch; and it seems that under these conditions, Class 5 holes also will have a tolerance of only 0.0005 inch, instead of 0.001 inch as stated. The same would be true of Class 4 holes, as well as of the other classes. This seems to indicate that in every tolerance class, when new reamers are used, a high grade of workmanship is required, because workmanship is the controlling factor in eliminating the variable in over-size cutting. Under production conditions, however, oversize cutting depends on many variables and cannot be easily predetermined.

Brass rod and cold-rolled steel are made with the tolerance as an addition to the nominal diameter. Drill rod is made with the tolerance below the nominal diameter. A standardized reamer which produces holes that will give the right clearance for one type of rod would not suit the other type.

The same would apply to holes for press fits as well as sliding fits. Sometimes there is a sliding fit in one part and a press fit in another part; or a running fit is used with either sliding or press fits. Here different diameter reamers will be required to produce the hole tolerances called for. Reamers taken from stock could not be expected to meet all these conditions; and if it were possible to wear the reamers down and use them for such holes as they might match, there would not always be an adequate supply of partly worn reamers to meet the demands of the shop. The new stock, therefore, must be such that it can be used for every production operation, as this is the fundamental requirement in assuring an adequate source of supply.

The system of plug gages for gaging the standard size holes, as referred to in the previous article, will not give the true size required for the following reasons: A plug gage that will enter a hole fits it with a sliding fit; therefore, it must be smaller than the hole. In the table, Class 6 holes for a 1/2-inch nominal diameter have limits of 0.5000 and 0.5005 inch. To enter the 0.5000-inch hole, a "Go" plug gage would have to be not more than 0.4999 inch in diameter. The "Not Go" plug gage must be of the same size as the maximum hole diameter, or 0.5005 inch. Referring to the table of gages for Class 6 holes, as given in the article referred to, we find the "Go" gage to be listed as 0.5000 inch minimum and 0.5001 inch maximum. Such gages would be used to inspect holes from 0.5001 to 0.5002 inch in diameter. The table lists the "Not Go" gage as 0.50045 inch minimum and 0.50055 inch maximum, which means that this would be the maximum size of the hole to be gaged as well. There are few shops that can definitely check a diametral measurement of plus or minus 0.00005 inch.

* * *

WELDING POWDER INQUIRY

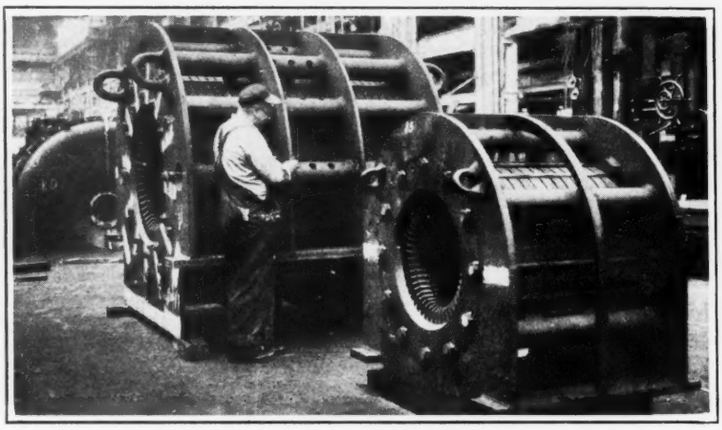
A correspondent from Waterbury, Conn., inquiring about welding powder for welding high-speed steel to shanks of cheaper grades of steel, failed to sign his name to his letter. If our correspondent will write us again, we shall be glad to answer his letter.

DIE FOR PIERCING OPPOSITE HOLES SIMULTANEOUSLY

By EDWARD HELLER

The piercing die described on page 197 in November MACHINERY is of novel design, but the writer fails to see wherein it possesses any advantages over the conventional slide type of die in which the punches are in a horizontal position and are operated by two cams or wedges secured to the punch-block. The writer believes that the latter type of die is far more satisfactory than the one previously described. The advantage of having the punches in a horizontal position is that the full stroke of the press can be utilized to advance the punches a comparatively short distance. Thus the operating cams can have very gentle slopes, while the design described in November MACHINERY must have the cam surfaces at an angle of 45 degrees, which is a very steep angle for operating a piercing punch on even very light gage metal.

The fact that the die has to be built so tall that it must be used in a press having a very high shut height is a great disadvantage, but the most undesirable feature of the design is the double cam arrangement that is used to force the lower punches upward. The two 45-degree cam faces develop so much friction that, although the punches might slide up and down at first when punching light gage metal, the moving parts would soon gather so much dust and dirt as to prevent them from working properly. If it is necessary to have the punches in a vertical position, it would be better to have the die or central member slidable and the lower punches stationary.



Westinghouse Turbine Generator Frame in which Welded Pipes Replace the Usual Ribs

* * *

NEW METHOD OF CONSTRUCTING GENERATOR FRAMES

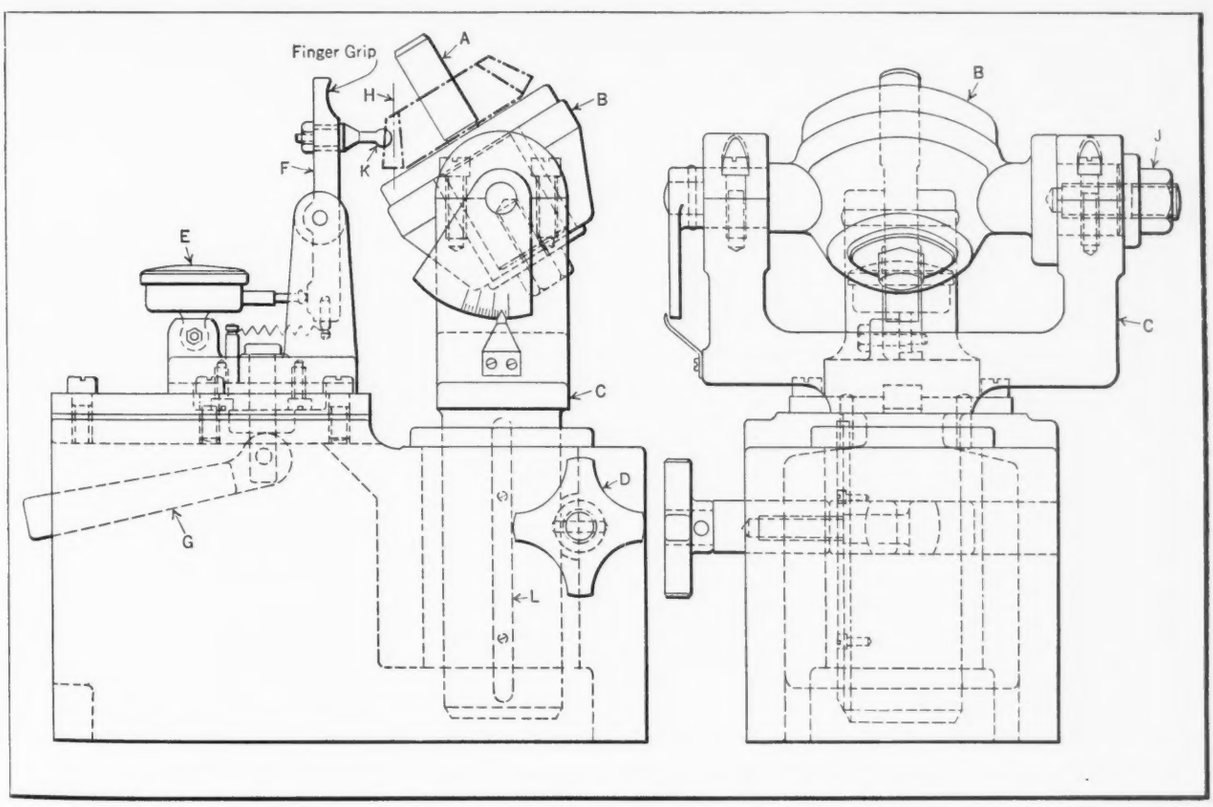
Welded pipes are replacing the usual ribs on the outside of turbine generator frames. In addition to their structural advantages, these tubes serve as air ducts. They take cooling air through the ends and discharge it through holes at the middle. The illustration above shows a Westinghouse turbine generator frame made in accordance with the new practice. It will be noted that lifting eyes are welded to the end plates. These lifting eyes are so placed that they are accessible even after the generator is enclosed by cover plates. This example brings out clearly the need for considering the method of construction in making the original design.

FIXTURE FOR CHECKING CONCENTRICITY OF BEVEL GEAR PITCH CIRCLES

By GEORGE PHILLIPS, New Brunswick, N. J.

In the illustration is shown a fixture for accurately and rapidly checking the concentricity of pitch circles of bevel gears. This fixture can be adjusted quickly to check gears having various diameters and tooth angles. The gear to be checked, which is shown in heavy dot-and-dash lines, is a slip fit on the plug *A*. Plug *A* is secured in the member *B*, the latter having two trunnions which are a slip fit in the split bosses of the bracket *C*. The bracket, in turn, is clamped in the base of the fixture by means of screw *D*.

The concentricity of the gear is determined by dial gage *E*. Any variation in the distance from the center of plug *A* to the pitch circle of the tooth results in a slight oscillation of the lever *F*, and this motion is transmitted to the dial gage, which registers the amount of eccentricity. The lever *F* and the dial are mounted on one plate, which can be moved along the machine base to suit the diameter of the gear being checked. When this plate



Fixture for Checking Concentricity of Bevel Gear Teeth of Various Angles and Sizes

has been located properly, it is clamped in position by means of the cam handle *G*.

In setting up the fixture, member *B* is swung upon its trunnions until the pitch line of the gear tooth indicated at *H* is in a vertical position, after which the member *B* is clamped by means of the nut *J*. The cam handle *G* is now released, and the indicator and ball point are brought to a position where the indicator reads zero, after which the cam handle is retightened. Each tooth is brought into position for checking by swinging the lever *F* to the left while the gear is being indexed.

Any position along the pitch line *H* can be gaged by raising or lowering bracket *C*, which is released for the purpose by clamp *D*. A plate of segment shape, graduated in degrees, is secured to one end of the trunnions on the member *B* and serves to locate the plug *A* at the required angle.

Rotation of the member *C* is prevented by means of a key *L* which engages the bore in the fixture base. If gears of different bores are required to be checked, the plug *A* may be replaced by one of suitable diameter, and if the sizes of the gears vary, the ball point *K* may be removed from the lever *F* and replaced by one corresponding to the pitch of the gear teeth being checked.

MILLING FIXTURE FOR DOVETAIL WEDGES

By OTTO R. WINTER, Mariemont, Cincinnati, Ohio

A very interesting set-up for milling dovetail wedges like the one shown on block *W*, Fig. 2, is illustrated diagrammatically in Fig. 1. Two blocks *W* are shown clamped in position on the swivel block or member *D* of the fixture with the milling cutters *C* just completing the dovetail wedges. The pieces *W* are held in place on member *D* by the clamps *E*.

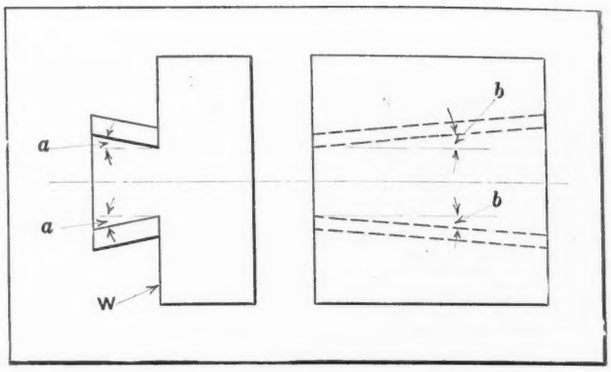


Fig. 2. Block with Dovetail Wedge Milled to Angles a and b

The upper face of the base *F* on which member *D* is mounted is machined to a compound angle with the milling machine table. This angular setting is calculated to produce the required dovetails when the blocks *W* are milled as indicated in the illustration.

At the first pass of the milling table, the cutter at the left mills the lower side of the tapered dovetail on one piece while the cutter at the right mills the upper side on the other piece. The block *D* is then indexed 180 degrees on the base *F*, causing the two pieces to change places. This arrangement permits the dovetail wedges to be completed on the two pieces at two passes of the milling machine table without releasing the clamps *E*.

Although not shown in the illustration, the member *D* is equipped with four clamps *E* and can be indexed to four positions. The two clamping positions shown in the illustration are at right angles to the ones not illustrated. This arrangement permits the fixture to be loaded while the cutters are at work. The cutters are thus kept in practically continuous operation.

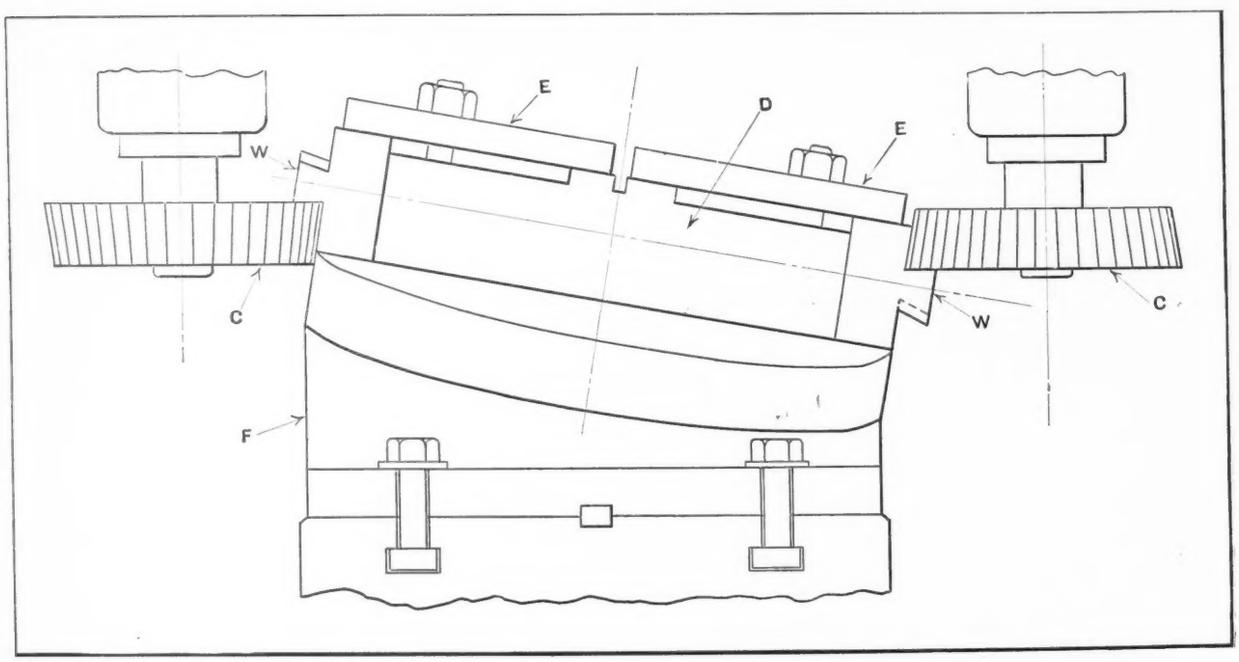


Fig. 1. Set-up for Milling Dovetail Wedge on Blocks W

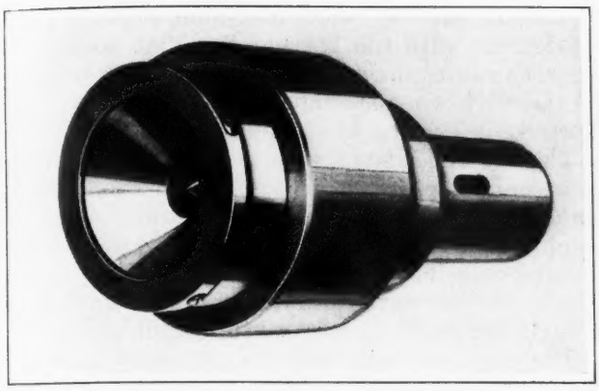


Fig. 1. Bellmouthed Centering Tool, a Cross-section of which is Shown in Fig. 2

BELLMOUTHED CENTERING TOOL

By W. N. DELENK, Windsor, Vt.

Accurate centering of shafts, studs, etc., in a turret lathe may be done rapidly with the tool shown in Figs. 1 and 2. The shank of this tool is held in the turret and the work is centralized as it comes in contact with the conical bore of the bellmouth *A*. The center drill *B* is fastened in the bar *C* by a screw *M*, the bar, in turn, being secured to the holder *D* by set-screws to prevent it from rotating. The sleeve *E* in which the bellmouth is mounted is a sliding fit over bar *C* as well as in holder *D*. Two pins *F*, fastened in the sleeve, slide in elongated slots in the holder, serving as a stop to prevent further sliding movement of the sleeve after the center drill has reached its full depth in the work.

The bellmouth *A* is so designed that it revolves with the work, a ball thrust bearing *G* being provided to take the thrust. Normally, the bellmouth is held in the position shown by the coil spring *H*. As the turret is fed to the left the work assumes the position indicated, while a further movement to the left will cause the work to force the bellmouth and sleeve *E* back into the holder. In the meantime, the centering drill has entered the work, pins *F* coming in contact with the surfaces *K* when the drill has reached its full depth.

Provision is made for lubricating the ball bearing by a felt ring *L* which is saturated with oil. To remove the center drill for grinding, screw *O* is taken out and set-screw *M* loosened by inserting a screwdriver through the hole *N*. The purpose of screw *O* is to prevent dirt from entering the holder. The cap *P* fastened to sleeve *E* serves to retain the bellmouth in the sleeve. Holes *S* in holder *D* permit the escape of air while sleeve *E* is in action.

SUPPORTING NARROW PROJECTIONS IN DIES

By D. A. BAKER, Long Island City, N. Y.

With the average blanking die, such as is used for blanking parts of small area from stock not exceeding 1/16 inch in thickness, the designer seldom has to worry about the strength of his die or die-shoe. However, when the thickness of the stock increases and requires larger dies, trouble may often be encountered if the die and die-shoe sections are not sufficiently large and well supported.

For example, the blanking die shown in the illustration has an overhanging projection *A*. If this die were used for making small blanks, probably 1 inch would be chosen as the die thickness. This thickness would provide ample strength, even though little support were given by the shoe to the projecting portion of the die.

On the other hand, if the size of the blank required were twice as large, the designer would probably increase the area of the top of the die in the same proportion, but would be likely to make the die thickness about 1 1/2 inches without taking

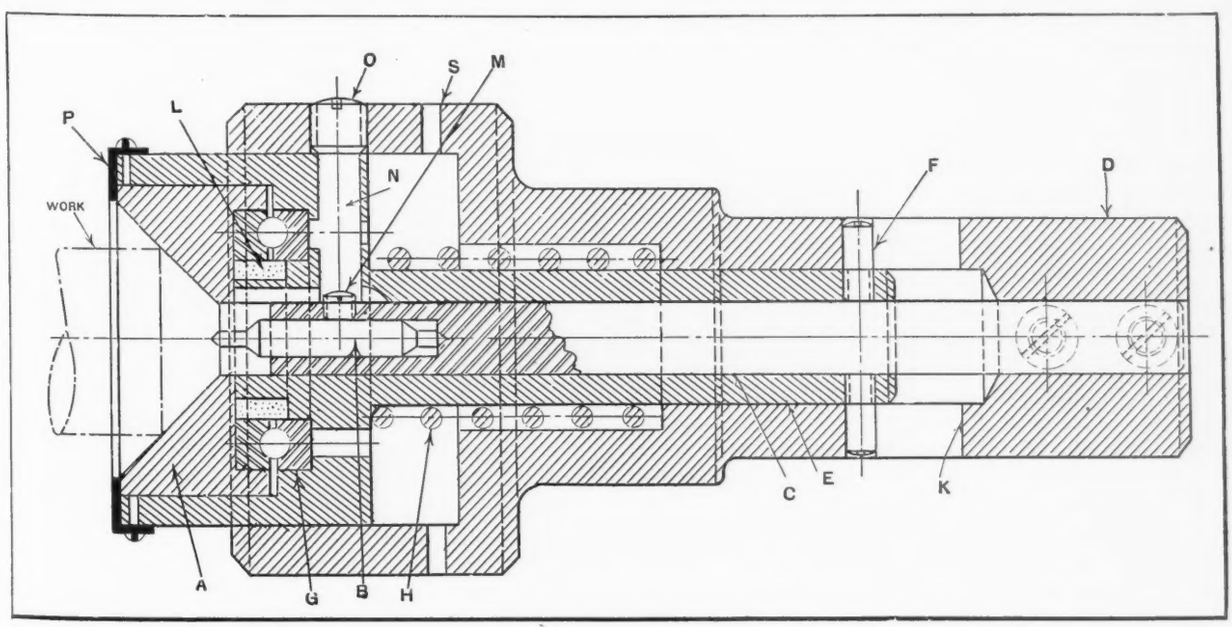
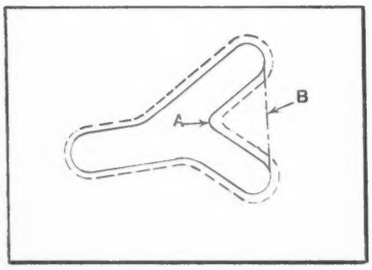


Fig. 2. Construction of Centering Tool Shown in Fig. 1, in which the Work is Held Concentric with the Center Drill by Means of a Sliding Bellmouth



Die which Requires Extra Support

into consideration the change in the pressure exerted on the die during the blanking operation. As a result the die might be sprung and broken.

To prevent this, the thickness of the shoe and of the bolster plate should be such as to offset the weakness in the die. A common fault in die design is the failure to provide the necessary thickness in these members. If insufficient support is provided for the projection *A*, the supporting part of the die-shoe will be peened down until the die loses its entire support at this point and is likely to crack or break along the line *B*. If the die is mounted on a cast-iron die-shoe, both die and shoe may be ruined, the projecting end of the shoe also breaking off.

If, on the other hand, the die is mounted on a steel shoe, it will be found that the surface beneath the die projection has been peened down or swaged out. In cases of this kind, the writer has frequently seen diemakers make new dies and mount them on the old shoes without first dressing off the face of the shoe. Obviously this should never be done, as there is then no support whatever under the weak section of the die, and therefore the new die will have a shorter life than the old one. In general, when a die cracks without apparent cause, it will pay to look at the die-shoe and press bolster to see that they are giving the die proper support.

HOLLOW-MILLING ATTACHMENT FOR DRILLING MACHINE

By ELMER C. COOLEY, Syracuse, N. Y.

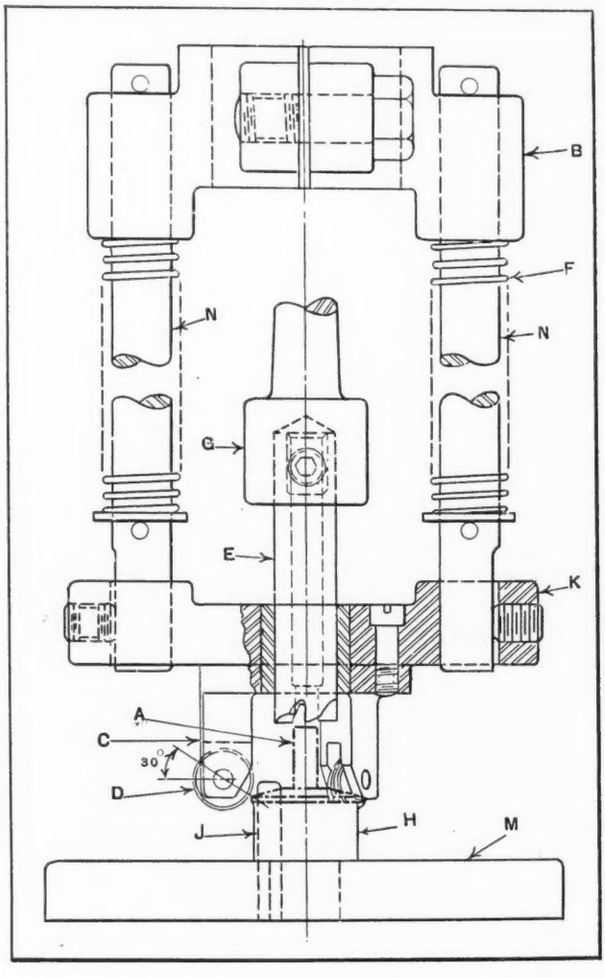
In the accompanying illustration, is shown a drilling machine attachment for hollow-milling the stems of cast-brass valve disks at the rate of 700 per hour. In using this equipment, the operator places the work *A* on the stud *H* and against two pins *J* which locate it in approximately the correct position for the hollow-milling operation. The workman places the piece in position with his left hand, keeping the spindle of the machine in almost continuous operation with his right hand. The machined pieces are ejected by compressed air.

The entire attachment, with the exception of the parts *J*, *H*, and *M*, is secured to the bracket *B*, which, in turn, is clamped to the quill of the drilling machine. The cage *C* holds three hardened tool-steel rollers *D* which clamp the work in place when the tool is fed downward. These rollers are spaced in circular formation with their axes equally distant from the center of the hollow-mill *E*, which is held in the drilling machine spindle by the special tapered-shank holder *G*. An 18-pitch sharp V-thread is cut on the peripheries of the rolls *D*. It will be noted from the illustration that a line drawn through the center of one of the rolls and the point of contact with the work makes an angle of about 30 degrees with the horizontal. This position of the rolls causes them to exert a heavy side pressure on the work when a comparatively light downward pressure is exerted by the springs *F*.

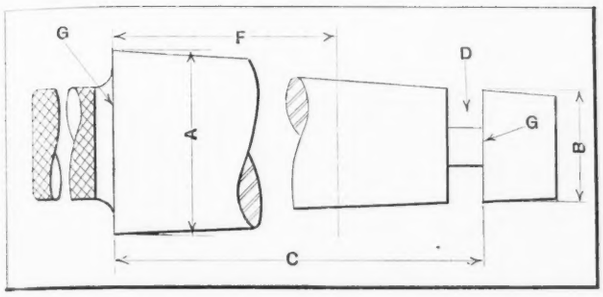
The fixture is shown with the rollers just coming into contact with the work. As the spindle continues downward, bracket *B* slides over the rods *N*, compressing springs *F* and causing the rolls to center and grip the work securely until the cut is finished. On the upward movement, springs *F* serve to strip the work from the hollow-mill.

The clamping rolls have an extremely long life, as they are free to turn on their axes and thus continually bring new points into contact with the work. The replacement cost of the rolls is very small. The lower assembly *K* can be adjusted to suit the length of the hollow-mill without affecting the adjustment of the springs *F*. The spindle can be raised to facilitate loading.

Attachments similar to the one described have also been used for drilling operations. Such devices seldom become obsolete, for when one job is finished, a few changes will permit them to be used on another part. Small rush jobs can be handled to advantage with equipment of this kind, as a centering cone and drill bushing are all that is usually required for the different types of work.



Hollow-milling Attachment with Work-centering Rollers



Method of Making Tapered Plug Gage to Facilitate Measuring with a Micrometer

MAKING AN ACCURATE TAPER PLUG GAGE

By H. C. MEYERS, Grand Haven, Mich.

The usual method of making a taper gage when a master gage is not available is to machine the gage to the finished dimensions, except the tapered part, which is ground to size after hardening, measurements being taken at the small and large ends of the taper. It is almost impossible to measure the small end of a taper accurately, especially when it is very steep. In many cases, the gage will show an error of from 0.001 to 0.003 inch, depending upon the skill of the operator.

The writer suggests a method for making direct measurements on this type of gage that is accurate enough for all practical purposes. Take, for example, the gage shown in the illustration, which is 2 inches in diameter at the large end and has a taper of 1.250 inches per foot. The usual procedure of turning, hardening, and grinding is followed. In this case, the gage is made longer than is required, and is grooved at *D*. The groove is cut a predetermined distance *C* from the large end. This distance should be an even number of inches—in this case, 8 inches.

The two surfaces *G* are first ground, the distance between them being accurately measured by means of a micrometer. The grinding of the taper can then be done very accurately, as measurements may be taken in a positive manner at the two high points *A* and *B*. The gage is finally cut off by means of a rubber wheel to any desired length, in this case to dimension *F*.

ASSEMBLING VENT SCREENS IN A DRILL PRESS

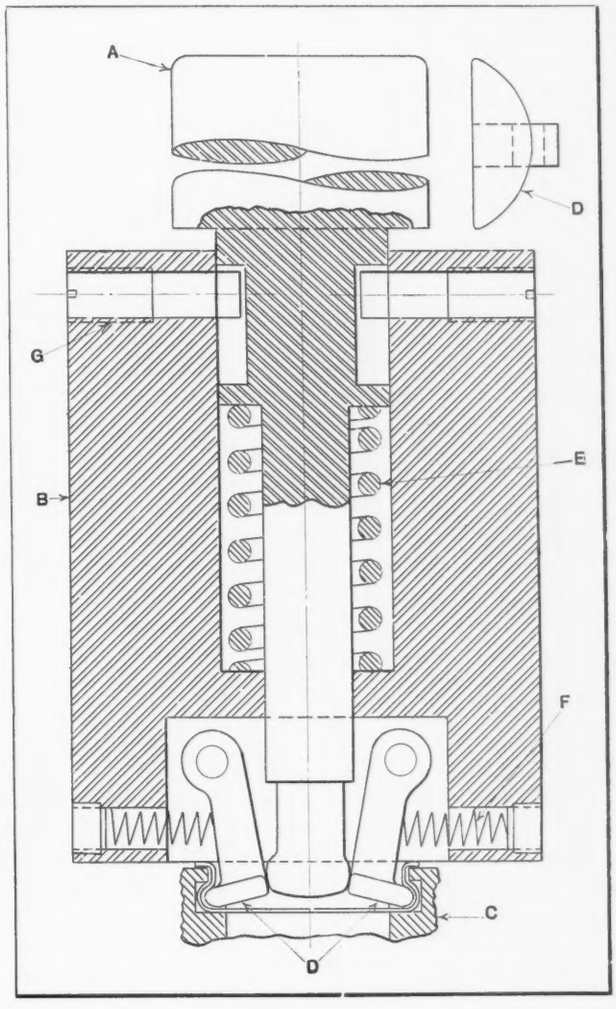
By FRED J. SCHLEGEL, Pottstown, Pa.

Many methods are employed for assembling wire screens over vent holes in various types of castings. One device designed for this purpose can be used in a drill press. This tool expands a brass screen with its reinforcing cap into an annular groove cut in the casting indicated at *C*. It is held in the drill press spindle, and in operation, is given a vertical movement only, no rotation of the spindle being required. The casting is stationary, and is held in a chuck (not shown) mounted on the drill press table.

Both the screen and the cap have flanges which are prevented from buckling or wrinkling while the tool is in operation by the pressure of the tool body *B*. This pressure is increased by the action of the spring *E* as the shank *A* descends. The lower end of this shank is of such shape that it forces the fingers *D* into the groove, thus expanding the inserted screen and cap. This movement of the fingers compresses the small springs *F*, and when the shank is raised, the fingers are forced toward each other, so that they clear the caps when drawn from the hole.

The movement of the shank in relation to the body *B* is limited by the length of the slots in which the ends of the screws *G* slide. When these screws come in contact with the lower ends of the slots, further upward movement of the machine spindle will cause the entire tool to rise from the work. All parts of the tool are made of steel, parts *A* and *D* being heat-treated.

Previous to the design of this tool, a brass screen having no flange was pushed into the groove by hand tools. However, this method, proved unsatisfactory, as some screens were pushed past the groove, and others dropped out while in service.



Tool Used in a Drill Press for Expanding Screen into Recess of Vent Hole

Use of Toolmakers' Cross-hair Microscope

Construction of Microscope for Locating Centers Established by Scribed Intersecting Lines

By DONALD A. BAKER

WHEN the position of a hole is accurately established on a piece of work by the intersecting point of two scribed lines, the usual procedure is to mount the work on the faceplate of a lathe to drill and bore the hole. If a high degree of accuracy is necessary, the button method is generally employed to locate the work so that the center of the hole will coincide with the center of the lathe spindle.

The cross-hair microscope described in this article provides a means of locating the work quickly and accurately without using the button method, which consumes considerable time. The cross-hair microscope was constructed by the writer as shown in the upper view of the illustration. It has given excellent results in locating work of various kinds, and as far as the writer knows, is the only one of its kind in use.

The microscope is provided with a holder such as shown by the two lower views of the illustration. By means of this holder, the instrument can be mounted on the toolpost of a lathe and so adjusted that the cross-hairs are in alignment with the center line of the lathe spindle. The microscope consists primarily of a simple brass tube *A*, the objective lens holder *B*, the eye-piece *C*, and the reticule *D* in which the cross-hairs are mounted.

With this instrument it is unnecessary to center-punch the work, as is generally done when the button method is used. Instead, the work is simply set up on the lathe faceplate with the microscope mounted on the toolpost. By adjusting first the work and then the microscope, the cross-hairs will, after a few trials, appear to rest in the centers of the lines scribed on the work. The adjustments must, of course, be continued until the cross-hairs line up with the scribed lines in all the four positions obtained by successively indexing or turning the faceplate through an angle of 90 degrees. In view of the advantages possessed by an instrument of this kind, it seems strange to the writer that none are available on the market or that they are not provided as regular equipment in the tool-rooms of large plants.

Obtaining Lenses for the Cross-hair Microscope

The following details of the microscope are given for the benefit of readers who may wish to construct a similar instrument for tool-room work. The objective cell *B* and the ocular or eye-piece *C* can be purchased separately from dealers in optical goods, with the lenses in place. The tube *A* and the cross-hair reticule *D* can be made up by the toolmaker. The tube *A* can be made from drawn brass tubing, and the reticule from brass rod stock. The combined magnification of the two sets of lenses should be about twenty times, and for convenience, the length of the microscope over all should not exceed 10 inches.

In response to an inquiry, the Spencer Lens Co., Buffalo, N. Y., recommended that their 48-millimeter objectives, which give a magnification of two times, be used in combination with one of their 10x ocular eye-pieces. These two sets of lenses, used together, give the required magnification of twenty times.

Except for the mounting of the cross-hairs in the reticule and the final alignment of the reticule, the average toolmaker should encounter little trouble. The outside of the reticule should be made a snug fit in the tube of the eye-piece *C*, the knurled head of which must be removable in order to permit the reticule to be pressed into place. After the reticule has been finished all over, it is centered in a bench lathe or dividing head for scribing the cross-hair lines, which must be exactly at right angles. These scribed lines actually form grooves in which to lay the cross-hairs.

Obtaining and Mounting the Cross-hairs in the Reticule

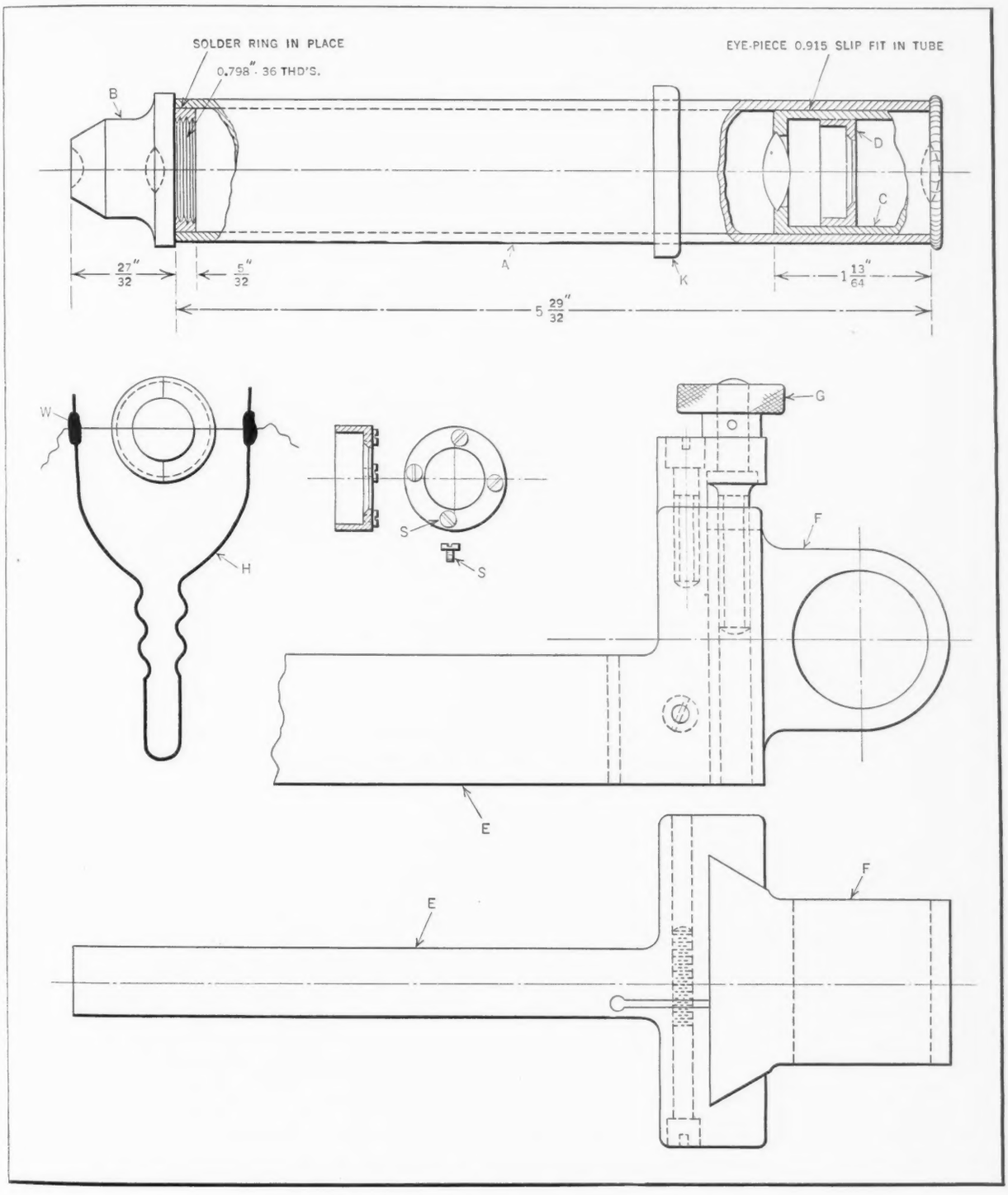
Silk fiber, spider web, or tungsten wire may be used for the cross-hairs. The silk fiber is the easiest to obtain, as it is only necessary to unravel a piece of silk thread sufficiently to obtain a single fiber of the required length. The so-called "spider web" is not the web found in the corners of attics, but is obtained from the cocoon that certain types of field spiders spin about their eggs. The writer does not know where this spider web could be obtained. Tungsten wire, however, can be readily secured in sizes as small as 0.001 inch in diameter; this is the most durable material, and the only one of the three mentioned that can be readily cleaned. In the case of tungsten wire, the cleaning is accomplished by passing the reticule through a flame so that any particles that cling to it will be burned off.

A hairpin *H*, with the ends spread apart and with small lumps of beeswax *W* attached as shown in the illustration, is employed for holding the cross-hair while mounting it on the reticule. One end of the cross-hair is first wound around the lump of beeswax at one end of the hairpin. The ends of the hairpin are then sprung together slowly and the loose end of the cross-hair is wound about the lump of beeswax at the other end of the hairpin. Thus, the spring action of the hairpin places the cross-hair under sufficient tension to keep it straight, and it can be placed in the grooves scribed on the reticule.

If spider web or silk fiber is used, a drop of shellac will serve to hold the ends of the cross-hair in place. If tungsten wire is used, it will be neces-

sary to drill and tap small holes at the sides of the grooves and use small screws such as shown at *S* to secure the wire in place. In making the grooves for the tungsten wire, care must be taken to have their depth less than the diameter of the wire. It will be noted that the holes for the screws *S* are on opposite sides of the center line of the grooves and so positioned that the tightening of the screws serves to increase the tension on the wire. This tension will often be sufficient to break the wire, and it may be necessary to make several attempts before a wire is secured satisfactorily. It is, of course, necessary that both wires be absolutely tight, without any slackness.

It will be noted that the objective cell *B* is screwed into a threaded ring soldered into the end of tube *A*. The eye-piece *C* should be a good wringing fit in tube *A*. The reticule, which must be adjusted to its proper position between the two lenses of the eye-piece, should be rather a tight fit, so that it will need to be driven lightly into place. The eye-piece is made a wringing fit in the tube in order to per-



Details of Toolmakers' Cross-hair Microscope and Holder

mit it to be adjusted to suit the vision of the user. When the microscope is in actual use, both the object viewed and the cross-hairs must be in perfect focus, so that they appear clear and sharp.

The holder adapted for use in the lathe toolpost consists of a shank *E*, a sliding block *F*, and an adjusting screw *G*. This construction provides a satisfactory vertical adjustment for the microscope, while the lathe cross-feed gives the required horizontal adjustment. The tube of the microscope is made a snug friction fit in the sliding block *F* of the holder, so that the cross-hairs can be turned to any position with respect to the lines scribed on the work. The ring *K*, soldered to the body *A* of the microscope, serves as a stop-collar for locating the instrument in the block *F*.

* * *

SQUARING SIX-FIGURE NUMBERS

By SAMUEL KAUFFMAN

The many users of MACHINERY'S HANDBOOK will be interested in the short method used by the writer for squaring numbers greater than those given in the HANDBOOK tables. The procedure consists of the following four steps: (1) Subtract the final figure of the given number from the given number, and add the remainder to the given number. (2) Multiply the sum by the last figure. (3) From the HANDBOOK get the square of the number which, in the first step, has been added to the given number. (4) Add the results obtained in the second and third steps to get the square of the given number.

Any number of five figures, less than 20,000 in value, and any number of four figures up to 9999, can be squared by this method.

Note that the actual step in subtraction is eliminated by duplicating all the figures of the given number, with the exception of the last; here a cipher is inserted, as shown. For example, square 15678 by the new method:

	15678
(1) add	15670
	31348
(2) multiply	8
	250784

(3) The square of 1567 is obtained from the HANDBOOK; and by adding two ciphers to it we get the square of 15670, which is equal to 245548900.

(4) Add results of (2) and (3)	245548900
	250784
	245799684

This equals the square of the given number, 15678.

Square 7854, using the same method:

	7854
add	7850
	15704
multiply	4
	62816

The square of 7850 equals	61622500
add	62816
	61685316

which equals 7854 squared.

It is possible to square any number by the method described if the following rule is applied: Place ciphers after the portion of the given number whose square can be obtained from the table of squares in the HANDBOOK, and then follow the same steps as before. For example, square 97867. Here it can be seen that the square of only the first three figures can be taken from the HANDBOOK, so ciphers are inserted under the last two figures of the given number, which are used when multiplying.

	97867
add	97800
	195667
multiply	67
	1369669
	1174002
	13109689

From the HANDBOOK, 978 squared equals 956484, and 97800 squared is 9564840000.

	9564840000
add	13109689

9577949689 which equals 97867 squared.

Square 199901:

	199901
add	199900
	399801
multiply	1
	399801

199900 squared equals	39960010000
add	399801
	39960409801

is equal to 199901 squared.

All numbers are to be treated as whole numbers; any decimals in them are to be placed after the final answer has been worked out; then the rule for decimals in squaring numbers is followed.

* * *

WESTERN METAL CONGRESS AND EXPOSITION

More than sixty firms have already taken space in the exhibition that will be held in connection with the National Western Metal Congress in the Civic Auditorium, San Francisco, February 16 to 20. The exposition promises to equal the one held in Los Angeles in January, 1929, both in size and interest. The program for the technical sessions will include contributions from nationally known engineers in the metal industry. The headquarters for the Metal Congress will be at the St. Francis Hotel, San Francisco, while the exposition, as mentioned, will be held in the Civic Auditorium.

Making Airplane Propellers and Wing Beams

By FREEMAN C. DUSTON

SEVERAL factors must be given careful consideration in constructing wood airplane propellers, among which may be mentioned the selection of the wood, the seasoning or drying process, the gluing up of the sections or laminations, the finish-shaping to accurate contour gages, and the balancing. In August MACHINERY, page 970, is shown a corner of the room where propellers and wing frames are made at the plant of the Moth Aircraft Corporation, Lowell, Mass. The stands on which the propellers are hand-shaped to fit the contour gages are shown to the left in the illustration.

In Fig. 1 of this article the propeller to the left is shown as it appears when glued up, preparatory to rough-shaping. The propeller in the center is shown in the rough-shaped condition, while to the right is shown a finished propeller, ready to be mounted on the engine shaft of a Gipsy-Moth plane. The wood used for the propeller is selected New England red birch, which is kiln dried to a much lower moisture content than the white spruce used for wing beams, such as shown in Fig. 2.

The gluing up of the sections or laminations of the propeller is done in a special jig. It is very important that the casein glue used for this purpose be properly mixed and that the correct amount of pressure be applied to hold the laminations together while the glue is setting.

Originally, all the laminations were made the same width and were glued up without staggering. This was done in order to permit the flat surfaces to be pressed together without tilting or opening up the joints at one side. When built in this manner, about forty-five board feet of material was required for a single propeller. With the improved method now in use, the various laminations are cut to different shapes, as indicated in the view to the left, Fig. 1.

This new method has not only reduced the amount of material required to twenty-five board feet, but in addition, permits the parts to be so cut and placed with respect to the grain of the wood that greater strength is obtained. The gluing jig which made this new method possible has stepped jaws or locating blocks which support the overhanging edges of the laminations and keep the different sections

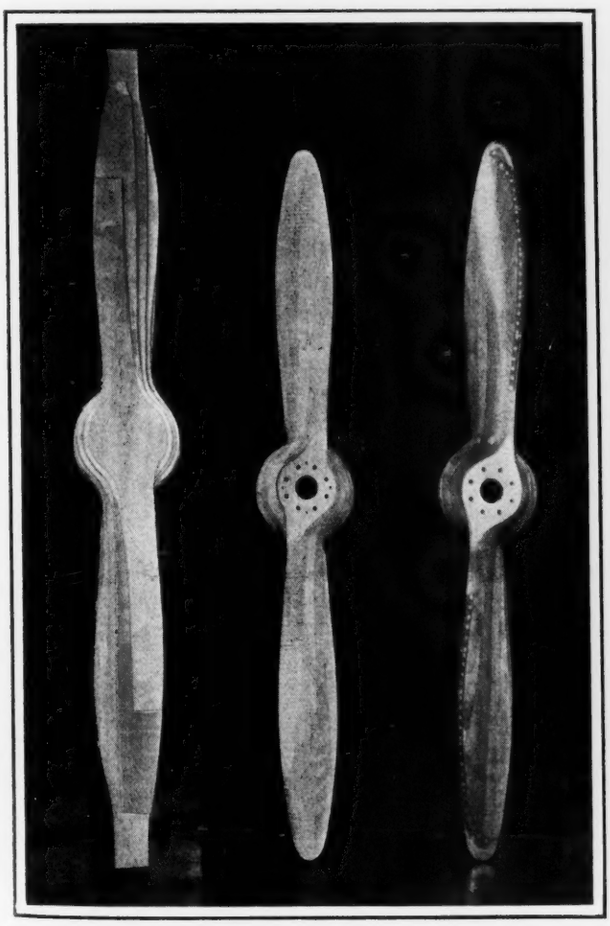


Fig. 1. Propeller in the Glued-up, Rough-shaped, and Finished Conditions

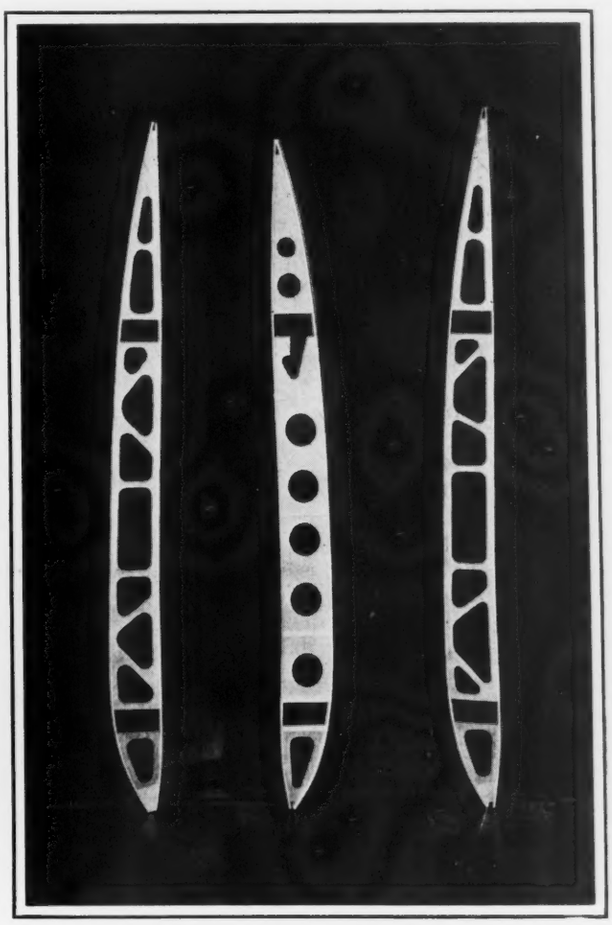


Fig. 2. Wing Beams of Laminated White Spruce Sections Cut to Shape and Glued

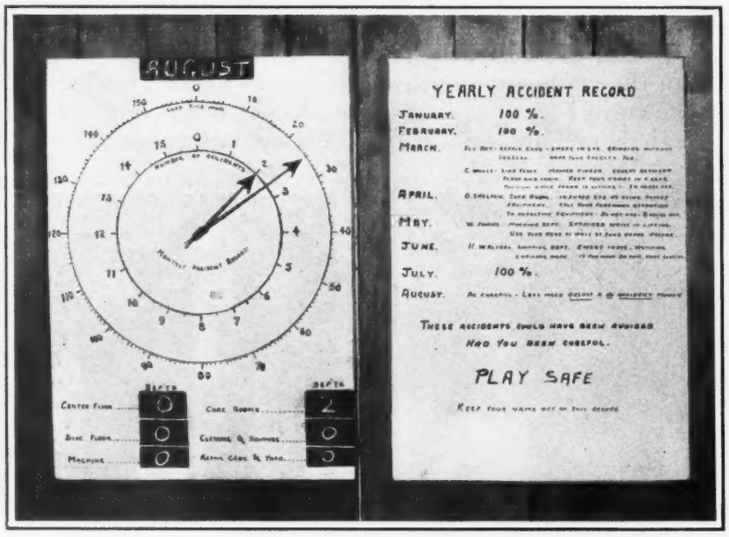
properly located while the pressure is applied. In this way, the jig prevents the joints from being opened on one side. The rough-shaping of the propeller and the boring of the holes, as shown in the central view, are done on a special machine.

The final finishing, however, is done by hand, using contour and height gages, as previously mentioned. The complete propeller has the leading edges protected by formed metal pieces, which are riveted in place, as shown in the view at the right, Fig. 1. A special knife-edged balancing machine is used for the final balancing operation. The procedure in gluing up the laminated webs of the beams shown in Fig. 2 is similar to that used for propellers. The openings in the webs are accurately formed on a routing machine, using jigs with contour templets, which assure a high degree of accuracy for this class of work.

Using Posters to Prevent Accidents and Stop Waste

By J. P. GLYNN

Both the number of accidents and the amount of scrapped material have been reduced at the foundry of the Elmwood Castings Co., Cincinnati, Ohio, by an educational campaign in which posters played an important part. The immediate results in the prevention of accidents were so gratifying that the prevention of waste was also included in the campaign by having posters that covered both subjects. As a result of the campaign, there were only five injuries in seven months. Only two of these resulted in a loss of time by the employes, the total time lost being thirty-two hours. The loss in scrap due to causes dealt with by the poster campaign has also been materially reduced. All this reduction in lost time and waste is attributed to the educational plan.



The "Clock" that Records Number of Accidents and Time Lost, and the Accident Record Poster

The earlier type of posters bore legends such as: "Safety is the daily application of common sense." "If you should lose a hand, which would you rather lose—right or left?" The posters now being used are made up by one of the clerical force. Various color combinations of cardboard and paint make them attractive. They are changed every ten days and are placed in conspicuous places throughout the plant. The new posters bear such notations as: "No molder would intentionally neglect to vent a mold, neither would you deliberately step on a rusty nail." "A molder is usually injured for the same reason that you would pour a mold short—failure to think." "You would not purposely break a casting, would you? Then why fall and break an arm? Think what you are doing."

Near the time-clock is a large poster, such as shown at the right in the accompanying illustration. This poster shows the cause of each injury, how it occurred, and advises how such accidents could have been prevented. This is a yearly record which includes the number of hours lost due to injuries. Near this poster is the clock board shown at the left in the illustration. This is a wooden board 1 inch thick by 22 inches wide by 30 inches high. The board has a white background and the outer graduated circle and long hand are painted black. The inner graduated circle, or dial, and the short hand are painted red. The black squares permit the month and other data to be marked down with white chalk. The short red hand points to the number of injuries during the current month. The long hand, which points to the outer graduated circle, shows the time lost in hours due to the accidents. The hands are held in place by a small bolt and can be readily set as required. The numbers of the departments in which the accidents occur are recorded in the black squares at the bottom of the board.

The whole system, including the clock board, the yearly accident record, the regularity in changing the shop posters, along with the graphic chart showing the percentages of scrap for the various departments, produces a keen rivalry among the different departments that has brought about a considerable reduction in the amount of material wasted and has practically eliminated serious accidents.

Multiple Tools Used on Vertical Turret Lathe

An Operation on Automobile Manifolds in which Economies are Effected by Taking Fourteen Cuts with Five Sets of Tools

AUTOMOBILE manifolds of the type shown in Fig. 3 and at *A*, Fig. 2, are machined complete at both ends in an operation performed on a Bullard vertical turret lathe. Fourteen cuts are taken by successively employing five sets of tools mounted on the turret, as illustrated in Fig. 1. With the manifold held in fixture *B*, Fig. 2, one end is machined complete and then the fixture is moved sidewise to bring the opposite end beneath the center of the turret. Identical cuts are taken on both ends. Threaded surface *e*, Fig. 3, has an outside diameter of 4 inches and the height of the manifold is 5 1/2 inches. It is a malleable iron casting.

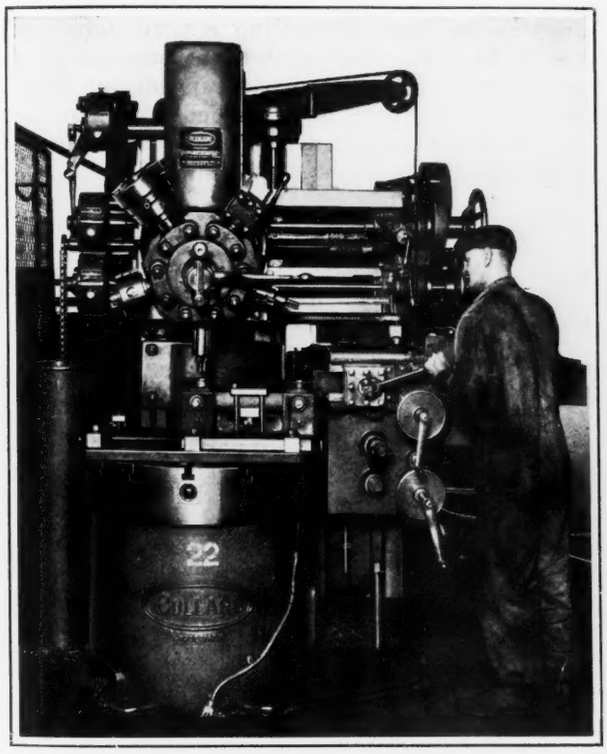


Fig. 1. Vertical Turret Lathe Set Up for Taking Fourteen Cuts with Five Sets of Tools

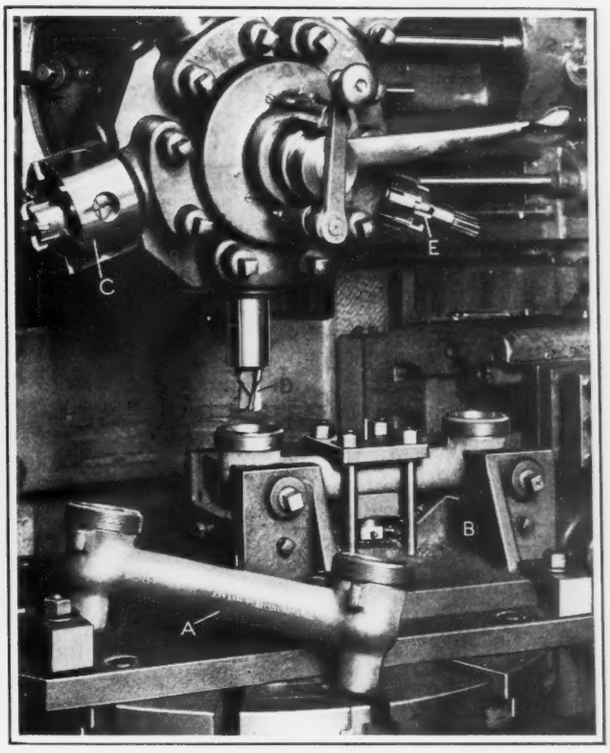


Fig. 2. Close-up View of the Boring, Facing, and Reaming Tools Used on Machine Shown in Fig. 1

One Tool-head Takes Five Cuts

The first step in an operation consists of using the multiple tools in head *C*, Fig. 2, for boring holes *a* and *b*, Fig. 3; facing surfaces *c* and *d*; and hollow-milling the outside surface *e*. This head, as well as the other tools seen in Fig. 2, was furnished by the Gairing Tool Co., Detroit, Mich.

Head *C* is fitted with four inserted blades for each boring and facing cut and six blades for the hollow-milling. In this tool-head are several holes 1 1/2 inches in diameter for the escape of chips produced by the hollow-milling blades.

The next step in the operation is performed with the two-stepped tool *D*. This tool core-drills hole *f*, Fig. 3, and chamfers corners *g* and *h*.

On account of the fact that the hole *f* is blind, or closed at the bottom, such a quantity of chips accumulates in the pocket formed by the closed end that they must be removed before the cut can be completed. Thus when the tool has been fed about half way into hole *f*, it is withdrawn and a magnet is placed in the hole to remove the chips. The core-drill is then fed into the work again for finishing the cut. In this step of the operation, the tool-holder serves also as a pilot, fitting snugly into the previously bored hole *a*. Cutter *D* has four spiral flutes.

Three Surfaces are Reamed Simultaneously

The multiple tool assembly *E*, Fig. 2, is next indexed into position for semi-finish-reaming bores *f*, *a*, and *b*, Fig. 3. The reamer for the small hole is a solid tool with a shank attached to the main tool-bar, while the cutter sections for the other two bores consist of six blades each.

The fourth set of tools, which is shown in Fig. 1, is mounted on a slide so that the tools can be fed sidewise after they have been lowered into place. One tool faces in back of surface *e*, Fig. 3, and the

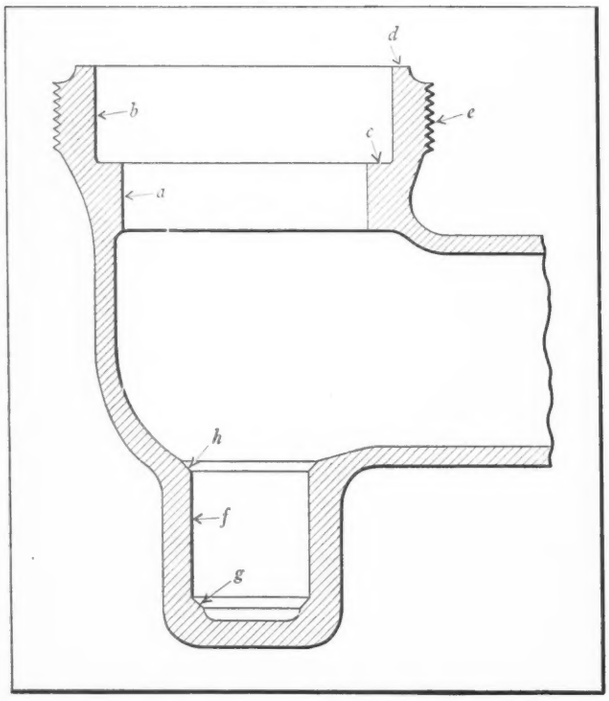


Fig. 3. Diagrammatic View of Automobile Manifold

other faces the lug which may be seen on the side of the casting at *A*, Fig. 2. The operation is completed by indexing the turret once more to bring the collapsible die-head seen in Fig. 1 into position for cutting the threads on surface *e*.

Twelve hundred manifold ends have been machined without resetting or regrinding any of the tools except the facing tool.

* * *

TOOL FOR FACING BOSS SQUARE WITH TAPPED HOLE

By STANLEY P. GOULD, Huntington Park, Calif.

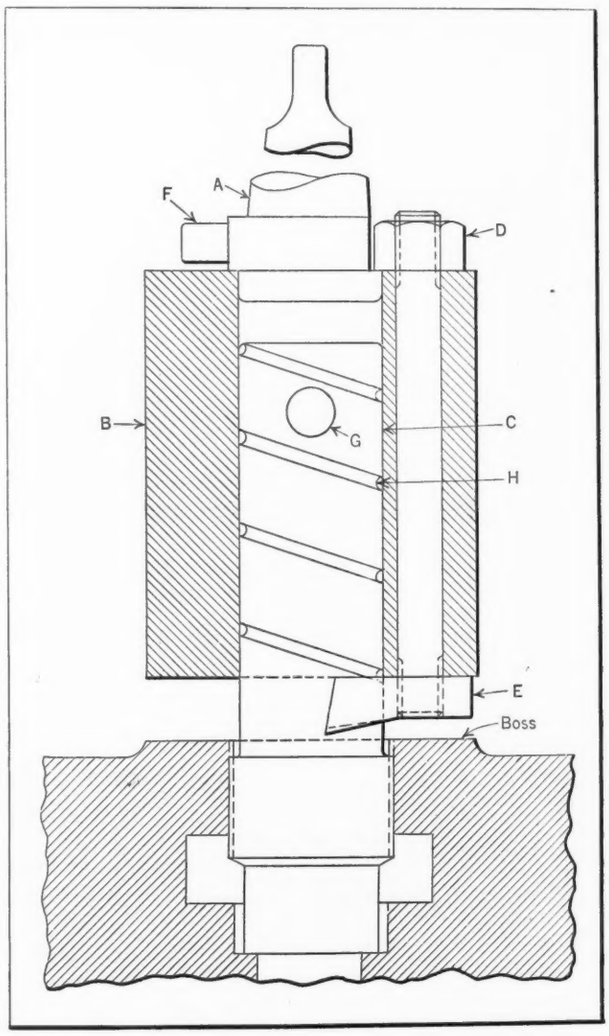
In a certain hydraulic pump, the valves are sealed by a bronze plug screwed into a tapped hole having a straight thread. This plug is flanged and secured tightly against machined bosses on the pump to form a water-tight joint. The tightness of the seal does not depend on the fit of the thread but on the fit of the flange. As the working pressure is 2000 pounds at this point, the fit must be very close in order to prevent leakage.

It was customary first to plane the bosses on the pump, after which the casting was drilled and reamed for the valve seats. At the same set-up, a hole was drilled and tapped for the bronze plug. It was found difficult, however, to tap the hole exactly square with the planed surface, and in order to prevent leaks, it was necessary to file and scrape each boss to fit the flanges on the plugs. This took a skilled mechanic four to eight hours.

Another method was adopted which proved more satisfactory. Planing of the bosses was omitted, but the scale was removed with a double-edge cutter in a drill press to avoid excessive wear on the finishing cutter to be used later. The holes for the valve seat and bronze plug were drilled, reamed, and tapped, the same as in the previous method. In the illustration is shown the tool for finishing the bosses. A pilot-bar *C* is provided for guiding the tool in the correct relation to the work. One end of this pilot is threaded and is a close fit in the tapped hole. The pilot-bar is also provided with a helical oil-groove *H* and a 1/2-inch hole *G* near the top, so that it may be screwed in and out of the casting by means of a bar. The sleeve *B*, which has a cutter *E* secured to it by a stud, is a close running fit on the pilot-bar. The sleeve is rotated by means of the drill spindle in which the shank *A* is mounted. The pin *F* secured in this shank engages the stud nut *D* and serves as a driver for the sleeve.

It is obvious that, with the aid of the pilot-bar *C*, the cutter *E* will face the boss on the top of the casting square with the thread. The edge of the cutter is serrated, so that a series of grooves is machined in the boss, permitting a very tight joint between the plug flange and the boss, as these grooves tend to embed themselves in the plug flange.

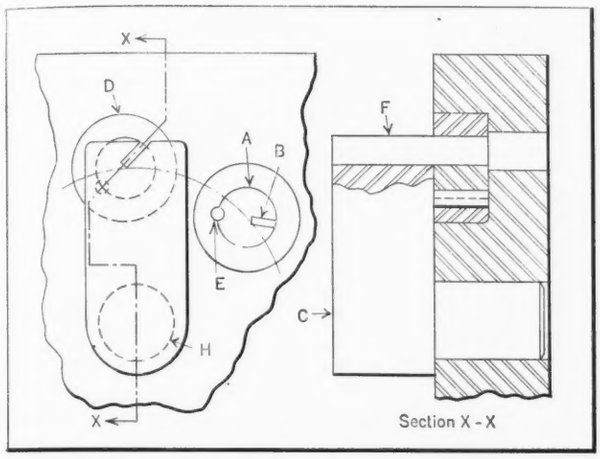
With this method, an unskilled workman can face the four bosses in less than an hour, and no trouble with leaky plugs is encountered.



Facing Tool which is Held Square by a Stationary Pilot

Ideas for the Shop and Drafting-room

Time- and Labor-saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Simple Gage for Locating Angular Die Inserts Accurately

GAGE FOR LOCATING INSERTS IN DIES

In assembling die inserts, like those shown at *A* in the illustration, it is necessary to locate each of the rectangular openings *B* at a certain angle with a line passing through the center of the hole *H* and the center of the insert. This is done by means of the gage shown at *C*. One end of the gage has a shank which is a slip fit in the center hole *H* of the die, while the other end is slotted. In the slot is soldered a blade *F* which is slightly smaller in cross-section than the opening in the insert.

To assemble the inserts, the outer ring *D* is first started into the die by hand. The insert *A* is then started into the ring in the same way, the dowel-pin *E* locating it correctly. The shank of the gage is now inserted into the center hole of the die and the insert and outer ring rotated with the fingers until the blade *F* drops into the opening in the insert. The ring and insert are then forced into the die to the proper depth by applying pressure by means of an arbor press on the upper surface of the gage. The other inserts are assembled in the same way.

New Britain, Conn. W. C. BETZ

REMOVING CHIPS FROM DEEP HOLES

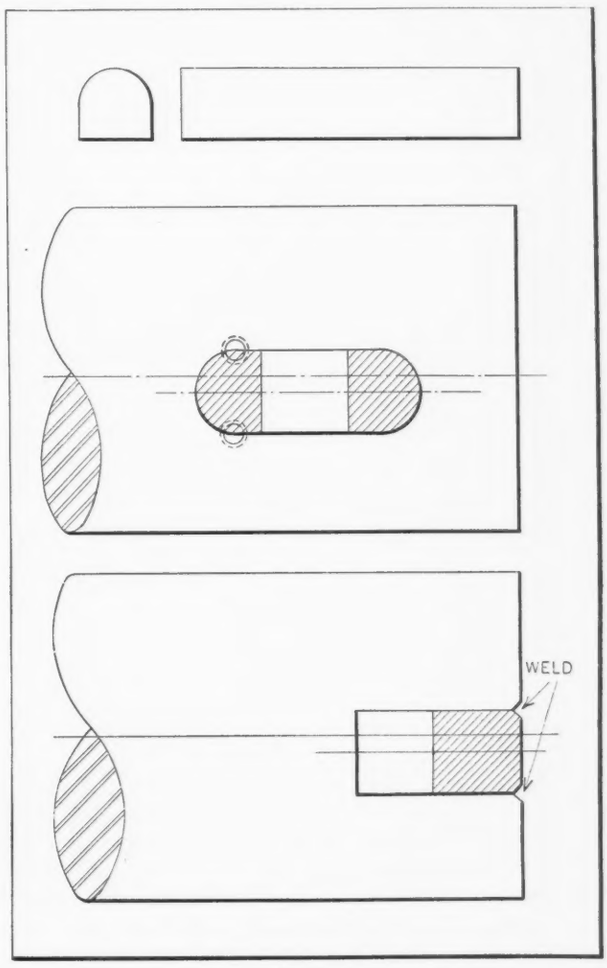
Although many kinks are used in the shop to facilitate work, the younger men are not familiar with all of them. One kink that has proved of great value to the writer is the use of a magnetized rod or round file for removing chips from the bottom of a drilled or tapped hole. The rod used may be made of cold-rolled steel and can be quickly magnetized by passing it between the fields of a convenient electric motor. This method, of course, can only be used for extracting iron and steel chips.

Herts, England W. E. WARNER

FORMING SQUARE HOLES IN BARS

It is often necessary, in making boring-bars, to cut a square hole for tool bits. This hole is usually off center, as shown in the illustration. Ordinarily, this is accomplished by drilling a hole and then filing it with a square file. Of course, this method applies only when one or a few square holes are to be cut, as otherwise a broach would be used. However, the methods shown are an improvement over the slow and awkward filing and chipping procedure, as they are more accurate and much quicker.

The hole is drilled and elongated, using a regular slot mill to cut the slot to a length equal to the length of the side of the square plus twice the thickness of the cold-rolled steel insert shown in the upper view. These inserts are fitted into the slot, as shown in the center view. The most efficient assembly is obtained if they are driven in. How-



Two Methods of Forming Square Holes in Bars Rapidly and Accurately

ever, they can be fastened by tapping small holes as indicated, half in the insert and half in the bar, into which screws are inserted and filed off flush. When a square hole is to be located near the end of a bar, the bar may be milled and the insert welded in place, as shown in the lower view.

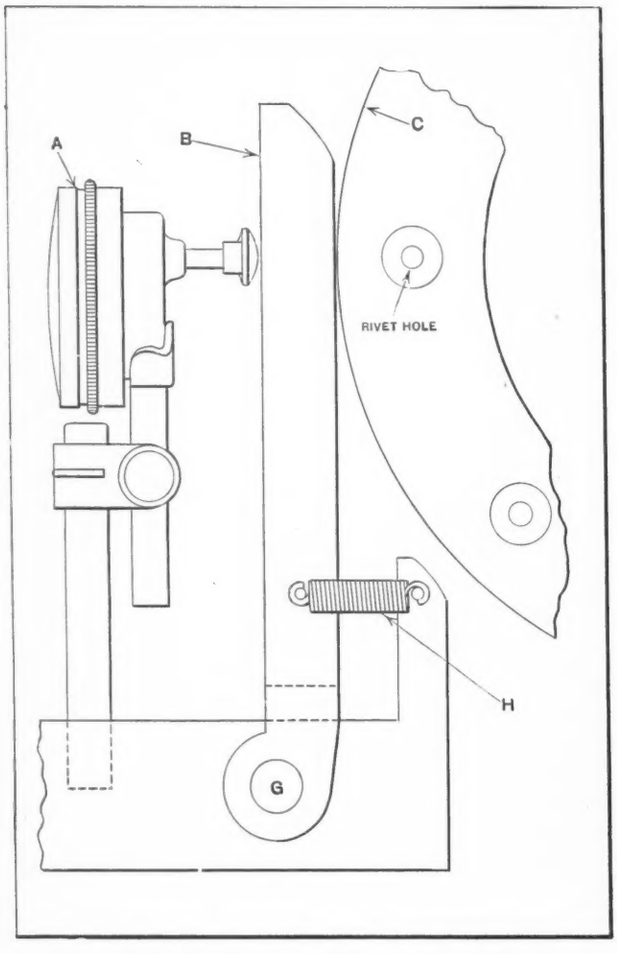
Baltimore, Md. RAYMOND H. DAUTERICH

CHECKING CONCENTRICITY OF A ROUGH SURFACE

In the manufacture of woven fabric rings for clutches, one of the final operations consists of checking the concentricity of the rings with the rivet holes. Because of the extremely rough surface on this material, it was impossible to use a standard indicator directly on the rings. However, this difficulty was overcome by the arrangement shown, in which the ring is located on a lathe faceplate fixture by dowels entering the rivet holes.

The standard indicator is used, but a swinging finger is interposed between the indicator point and the surface of the ring *C*. The finger is pivoted on a holder at *G*, and is kept in contact with the work by means of the coil spring *H*. In the holder, which is secured in the toolpost of a lathe, is mounted the dial gage *A*. As the work is revolved, any eccentricity is transmitted to the gage through the bar *B*.

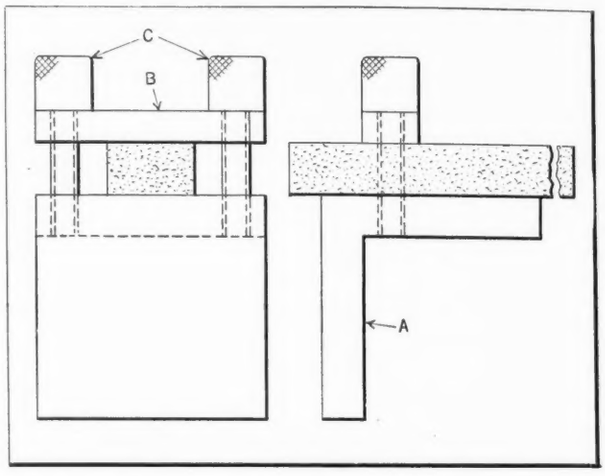
Norwood, Mass. J. S. REA



Gaging Concentricity of Woven Clutch Ring

HOLDER FOR KEEPING OILSTONE SQUARE WITH WORK

In stoning contour gages and templets, the oilstone must be held square with the work. Usually much skill is required for this operation. The accompanying illustration shows a simple holder that



Simple Holder for Keeping Oilstone Square while Stoning Contours on Gages and Templets

insures that the stone will always be square with the work.

It consists of an angle-iron *A* upon which the stone is clamped by means of the strap *B* and the two knurled screws *C*. The open face of the angle-iron is held flat against the side of the work, so that the edge being finished by the oilstone will be square. As the stone wears, it may be pushed out to present a new surface to the work.

The angle-iron is made of tool steel and is hardened and ground, while the clamp is made of cold-rolled steel. By the aid of this holder, the workman can devote his entire attention to obtaining the correct outline.

Scotia, N. Y. SEYMOUR SCHREITER

MAKING INEXPENSIVE DIES FOR DIE-CASTINGS

A method of making inexpensive dies for die-casting machines that is being used successfully in one plant is as follows: A wooden core-box or pattern like the die to be made is rammed up in an ordinary sand mold. After the pattern is withdrawn from the sand, the mold is sleeked well so that it imparts a good smooth surface to the casting.

When the casting of the die is taken from the sand, the surplus metal is removed by small emery wheels and Carborundum powder. Thus a bright surface is produced in the die cavity, which gives the die-castings the appearance of being polished. This method of producing the dies eliminates the expensive die-sinking operations ordinarily employed, the only machine work required being performed with flexible shaft equipment.

Preston, Victoria, Australia C. J. DROLZ

Questions and Answers

RATIOS OF WORM-GEARS

A. M. S.—When worm-gears are applied to truck and bus drives in connection with the rear axle transmission, what ratios are commonly used, and is the required speed reduction obtained through the worm-gearing alone?

A.—The flexibility of worm-gearing in regard to the speed ratio is one of its important features, and since this ratio equals the number of worm-gear teeth divided by the number of worm threads, various ratios are possible for a given center distance.

When worm-gearing is applied to commercial trucks, and it is extensively used for this purpose, ratios of about 8 to 1 are common for the lighter trucks, whereas for the heavier trucks the ratios may be 15 or 16 to 1. When the speeds of truck engines vary from 1200 to 1500 revolutions per minute, gear ratios varying from 8 to 1 to, say, 13 to 1 provide for the road speeds ordinarily required for commercial trucks.

The worm-gear drives applied to buses or passenger-carrying vehicles must give smaller speed reductions, because higher road speeds are required than for commercial trucks. The engines used have higher speed ranges and some of the worm-gears used for the rear axle transmissions of buses have ratios of only 4 or 4 1/2 to 1, ranging up to about 6 to 1.

The speed reduction is obtained through the worm-gearing alone, thus simplifying the drive, as compared with transmissions involving two steps of reduction through either bevel and ordinary spur gearing, bevel and internal spur gearing, or the bevel gearing and chain-drive combination. Unless worm-gearing is used, it is difficult to obtain the ratios of reduction required, especially for the heavier trucks, if wheels of ordinary size are to be employed. For this reason commercial trucks or vehicles, unless equipped with pneumatic tires, have either a rear axle transmission of the worm-gear type or some design of double reduction transmission.

The ratios referred to in connection with truck and bus drives are readily obtained by using worm-gearing of the multiple-threaded type. These multiple-threaded worms, provided with triple, quadruple, or perhaps a larger number of threads, not only give the ratios desired for a given center-to-center distance between the worm and worm-gear, but the use of multiple threads in conjunction with worms that are as small in diameter as is consistent with the torsional strength required, results in large lead or helix angles. These large helix angles, in turn, have an important bearing upon the efficiency of the worm-gearing, as the maximum efficiencies usually occur when the lead angles are between 35 and 45 degrees. The efficiency, however, remains about maximum over a much wider range if the coefficient of friction is small, and this coefficient may be subject to great variation, as it is decidedly affected by the kind of lubrication used.

DELAYING EXAMINATION OF PURCHASED MACHINERY

E. B. N.—About six months ago, our company ordered several hand-operated machines, believing we had immediate use for them. When the machines were delivered, we had no use for them. However, after we had casually examined them, we paid the bill. A few weeks ago, we had use for these machines and on setting them up, discovered that they were not practical. We wrote the manufacturer explaining that we had not tested the machines until this late date, and we found that they were not practical for our purposes and not equal to the quality specified in the contract. They refused to refund the purchase price, stating that we had delayed too long in making the complaint. As these machines are not equal to the samples shown to us, we feel justified in compelling this seller to refund our money and take the machines off our hands. Can we do this?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

Generally a dissatisfied purchaser is expected by the law to file a complaint within a reasonable period of time after the goods are accepted and paid for. Just what is a reasonable time depends upon the circumstances in each case. In one case (262 Pac. 939), where it was impractical for the buyer to inspect the goods thoroughly, it was held that a delay of three months was not unreasonable. In another case [1 S. W. (2d) 1056], a purchaser did not examine certain delivered merchandise before storing it away. Four months later, when he discovered that it was defective and not fit for the intended purpose, he sued to recover the purchase price. However, the Court held the seller relieved of liability and said:

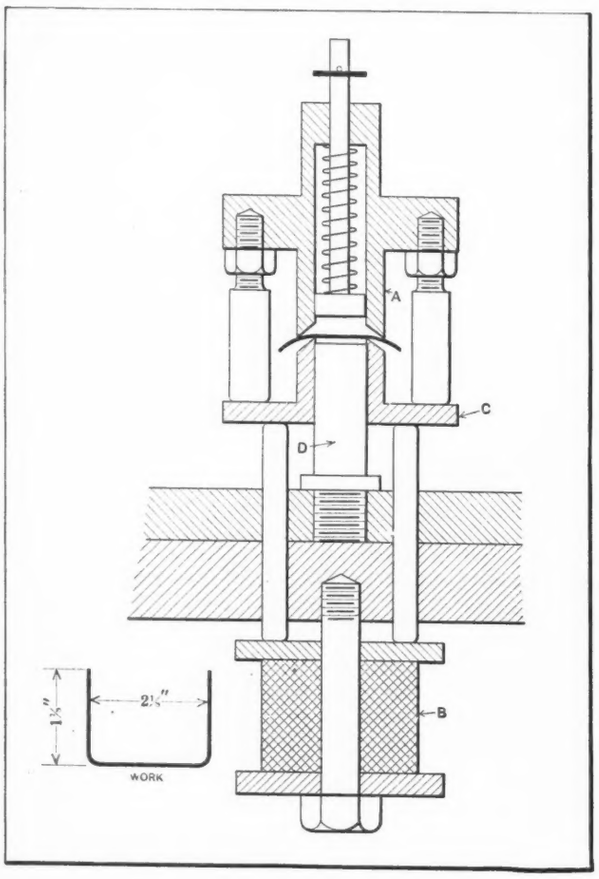
"Where goods are delivered to a purchaser on an executory contract of sale and the purchaser accepts the goods after inspecting them, or after having a fair opportunity for inspection, he is held to have accepted them as a full compliance with the contract and cannot maintain an action for damages on the grounds that the goods are defective or do not measure up to the terms of the contract."

Therefore, it is my opinion that you have lost your rights to recover from the seller, since you delayed an unreasonable period before filing the complaint. The machines should have been tested before paying for them.

DIE FOR DRAWING DEEP SHELLS

J. S. D.—Will some reader who has had experience with drawing dies for producing shells about 2 1/4 inches in diameter by 2 inches deep, show the design of a die which has given satisfactory results on this class of work?

A.—In the accompanying illustration is shown a type of deep drawing die used successfully in producing shells of the size indicated by the cross-section view in the lower left-hand corner of the illustration. The die is provided with a rubber buffer *B* which acts against the lower blank-holder *C* through pins spaced evenly around the punch. An interesting feature of this die is the upper blank-holder or reducing ring *A*, which is provided with



Die Used for Drawing Deep Shells

adjustable studs or pins. These pins equalize the pressure applied by the buffer *B*.

The position of the blank is indicated by heavy lines as it would appear resting on the lower blank-holder *C* after the ram has descended sufficiently to bring the adjustable pins in contact with the lower blank-holder. As the ram continues to descend and the buffer is depressed, bevel faces of the upper and lower blank-holders grip the blank. The drawing punch *D* forces the blank into the forming recess in the upper member *A*. The formed shell forces the knock-out upward against the tension of the spring. Although not so shown, the end of the drawing punch is rounded to conform with the radius at the bottom of the shell.

PIERCING HOLES IN A BRASS PART

Answered by William C. Betz, New Britain, Conn.

Referring to the inquiry on page 47 of the September number of MACHINERY concerning the best method of piercing or perforating holes in a brass part, the writer doubts the advisability of performing this operation on a punch press, because of the relative thickness of the stock. Though it may be possible to pierce the holes, the upkeep cost would be prohibitive because of punch breakage. Furthermore, the opposite sides of the holes produced would not be parallel because of the great amount of clearance necessary between the punch and die hole. Another bad feature resulting from the large clearance would be the distortion of the hole, as well as the sides of the piece.

It is suggested that a leaf jig be used and the holes drilled by means of straight-fluted, high-speed drills, the jig being designed so that two pieces could be drilled at one time. This idea could be improved upon further by designing a special drilling machine having a magazine feed operating in conjunction with a suitable work-holder.

VIBRATION OF MACHINERY AFFECTING ADJOINING PLANT

R. S.—A manufacturing plant maintains an experimental laboratory in connection with its business in which delicately adjusted appliances are used. The plant is located in a factory district, and has been in the same location for about ten years. The surrounding factories in no way interfered with its laboratory work up to a short time ago, when an adjoining factory installed a high-speed Uniflow engine and generator to generate electric power for its own use. The vibrations from this machinery create such a disturbance as to interfere seriously with the work in the laboratory. The factory declines to insulate the foundations of its engine, which could be done at a reasonable expense, and thus reduce the vibration, on the ground that since it is located in a factory district and its engine is of approved construction, it is within the law in operating it as installed. Has the injured plant any legal remedy against this condition?

Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.

The mere fact that a plant is located in a factory district will not give it any right to inflict injury by the vibration of its machinery upon adjoining property owners. Of course, occupants of such a district are required to endure the noise and disturbances incident to such a neighborhood, but when such a disturbance reaches a destructive point in its effect, it may well be held a nuisance. On the facts as stated, there is little doubt but that a court would enjoin the further operation of the Uniflow engine and generator and require proper insulation as a condition of its operation. In addition, the factory would no doubt be held liable for any damage caused adjoining property by the operation of its equipment as described. (128 Atl. 872)

Results Obtained with Stellite Cutting Tools

A Review of the Types of Machining Operations for which Haynes Stellite Cutting Tools have been Found Suitable During Many Years of Application in Shop Practice

IN a paper on Stellite cutting tools, read before the annual meeting of the American Society of Mechanical Engineers and referred to on page 372 of this number of MACHINERY, the authors pointed out that no one tool alloy has yet been found to be the most economical for all kinds of machining operations. However, general rules are of some value, although there may be exceptions to them. The authors, therefore, gave the following general statements as a guide in selecting cutting tools.

Operations for which Stellite has been Found Suitable

Machining may be divided into four general divisions. One of these consists of the machining of cast iron, semi-steel, and malleable iron. The second division consists of machining mild steel when the operation is done under conditions having a considerable degree of rigidity, that is, when the steel casting or forging is of a rigid section, the number of tools used is small, and the machine is heavy and in good condition. The third type may be said to include the machining of light steel parts on automatic or semi-automatic machines and the machining of alloy-steel parts. The fourth class covers a miscellaneous group of materials, such as chilled iron, brass, bronze, aluminum alloys, hard rubber, fiber, mica, etc. These materials are grouped not because of similarity, but because of their minor importance. It may be said that Stellite cutting tools are nearly always successful on the first and second classes, have met with but little success in the third class, and have come into wide use on some materials in the fourth class.

Milling Operations Performed with Stellite Tools

Stellite used for milling has been most successful on cast iron, including all grades from gray to semi-steel; the production figures given will be confined to examples on this material. In the last few years, however, owing to improvement in strength and cutting quality, a few milling operations on steel have been, and are being, successfully done with Stellite. Although at the present time the extent to which steel is milled with Stellite is very limited, there is reason to believe that applications of this kind will increase greatly in the near future.

Milling has been divided into three classes—heavy, medium, and light; the first two classes are done on such work as cylinder blocks, cylinder heads, and crankcases, and the latter on chain-case covers, manifolds, bearing cups, and other small parts. A typical example of each of these classes of operations is given.

In milling rough cylinder blocks top and bottom, as well as the manifold bearing cap slots and valve-cover pads on a line-type milling machine, between thirteen and fourteen pieces are finished per hour, using a surface speed of 110 feet per minute, a feed of 10.5 inches per minute, and a depth of cut of 1/8 inch. This is about two and one-half times the production obtained on this work by the type of tools employed before Stellite was used.

In medium milling, cylinder blocks are roughed and finished top and bottom on a drum-type milling machine at the rate of thirty-four pieces per hour, with a surface speed of 120 feet per minute, a feed of 18 inches per minute, and a depth of cut of 1/8 inch. The production is double that obtained with the tools formerly used.

As an example of light milling, the machining of manifolds on a vertical mill may be recorded. Thirty-seven pieces are completed per hour, with a surface speed of 148 feet per minute, a feed of 15 1/4 inches per minute, and a depth of cut of 1/8 inch. Formerly twenty-nine pieces were completed per hour. It is of interest to note, however, that the machining time has been almost cut in half from one minute one second, to thirty-three seconds. It is the clamping of the manifold in the machine and its removal that takes the larger part of the floor-to-floor time.

In a study of miscellaneous milling operations covering practically every phase of milling on which Stellite cutters are used, it was found that it is possible to increase, on an average, the cutting speed by 63 per cent, the feed by 59 per cent, the number of pieces per grind by 139 per cent, and the production by 55 per cent.

Application of Stellite for Boring and Turning Operations

Stellite tools are used for rough-boring cylinder blocks more extensively, probably, than for any other single boring operation. Cylinder blocks for eight well-known cars are bored at cutting speeds varying from 52 to 104 feet per minute, with a feed varying from 4 1/2 to 8 1/2 inches per minute. In one instance, the production is 143 per cent greater than it was with the tools used before Stellite was introduced.

Turning operations with Stellite tools cover a larger range of work than either milling or boring. It is well known that Stellite is successful on cast

iron under almost any conditions. However, the first use of Stellite cutting tools on a large scale was for turning steel shells during the war. Steel can be machined successfully and economically with Stellite tools, especially for taking roughing cuts with round-nosed tools, when the work is supported rigidly and it is not necessary to machine to sharp corners.

As an example of a turning operation may be mentioned the turning of cast-iron bearing retainers on a semi-automatic lathe, where the actual machining time was reduced from two minutes forty-four seconds to one minute fifty-five seconds by the use of Stellite, and the number of pieces completed between grinds from 150 to 250. In rough- and finish-turning a cast-iron flywheel, production was increased 60 per cent by reducing the machining time from approximately 12 1/2 to 7 1/2 minutes, and increasing the number of pieces produced per grind from twenty to forty-eight. In turning a rear-axle shaft, production was increased 93 per cent. In this case, the surface speed was increased from 66 to 110 feet per minute, and the feed per revolution from 0.015 to 0.021 inch.

In turning bronze, surface speeds have been increased from 78 to 131 feet per minute, and production by 50 per cent.

If an attempt be made to average the results obtained in the use of Stellite tools on operations for which this cutting material is adapted, a comparison with the results obtained by the tools formerly used might be briefly given as follows:

	Increase in Production Per Cent
Milling cast iron	25 to 100
Boring cast iron	25 to 110
Turning cast iron	20 to 140
Milling mild steel	25 to 35
Boring mild steel	30 to 120
Turning mild steel	15 to 125

The increase in number of pieces per grind may be stated as follows: Milling cast iron, from two to five times; boring cast iron, from two to six times; turning cast iron, from two to five times; milling mild steel, from two to three times; boring mild steel, from one and one-half to five times; and turning mild steel, from one and one-half to six times.

Assembling New Type Lock-washer on Nuts

Automatic Machines Developed to Assemble Lock-washers of a New Design on Nuts and Screws at the Rate of from 80,000 to 125,000 a Day

THE object of the "Bracketite" principle of assembling lock-washers on nuts and screws is to simplify the work of assembling machines or parts that require lock-washers for screws, nuts, or other threaded members. The cross-sectional views at *B* and *C*, Fig. 2, show a nut and a cap-screw with lock-washers assembled in place.

The "Bracketite" screw products are manufactured for the market by the National Machine Products Co., 4850 Bellevue Ave., Detroit, Mich. Plans have been made for licensing other manufacturers to make these products, for which purpose they will be furnished with assembling machines built by the National Machine Products Co. Arrangements have been made with a manufacturer of split lock-washers to supply washers of the special form required, as indicated in Fig. 2.

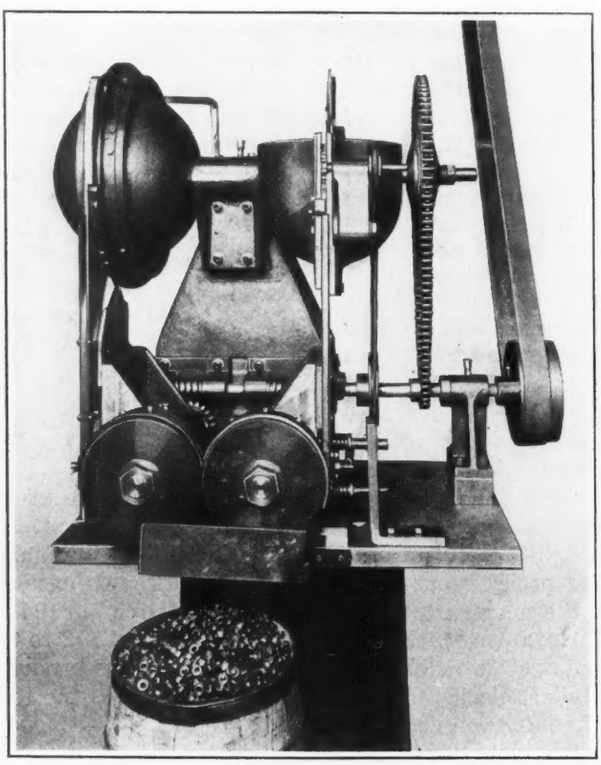


Fig. 1. Machine which Assembles 125,000 Nuts and Washers a Day

One of the machines developed for assembling nuts and washers of the type shown at *B* is illustrated in Fig. 1. The simplicity of the assembling operation makes it possible to sell the assembled units at a price no higher than that of the nut and washer when sold separately. The machine illustrated was designed to assemble nuts and washers from 1/4 to 1/2 inch in diameter. The nuts are made on automatic screw machines with the under-cut shoulder as shown at *B*, Fig. 2.

There is a hopper at each side of the machine.

The nuts are shoveled into one of these hoppers and the washers into the other. The hopper carrying nuts is furnished with a dial feed in which slots are cut around the periphery. As this dial revolves in the hopper, the shoulder on any nut can enter the slot in the dial, but the body of the nut is too large to be admitted. As the shoulders enter the dial, the nuts are carried around and dropped into a feed chute which carries them down to one of the two rollers at the front of the machine. This roller, in turn, carries them around with their shoulders facing outward.

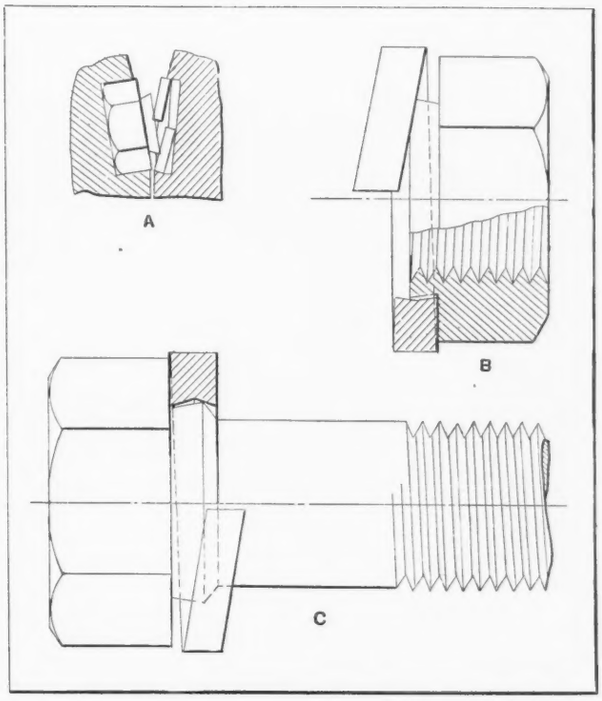


Fig. 2. (A) Rolls about to Assemble Nut and Lock-washer; (B) Nut and Lock-washer; (C) Cap-screw with Washer

It is immaterial which way the washers drop from the hopper into the feed chute. In the hopper there is a revolving spider which agitates the mass of washers, causing them to pass down through the chute to the other roll at the front of the machine. On the main shaft there are two worms driving the two rolls in opposite directions. The drives to these two rolls are accurately synchronized so that each successive nut in one roller meets with its respective washer in the other roller. The view at *A*, Fig. 2, shows a nut and a washer in their recesses, with the rollers approaching the position where the two parts are forced together or assembled.

The rollers are slideably mounted and are backed up by heavy tension springs so that if a defective piece enters the machine, sufficient play is provided by the springs to allow the rollers to back away without damaging the mechanism. The production of this machine has been as high as 126,000 assembled pieces in a ten-hour day. Other machines will be built for different sizes of nuts.

The method is especially well adapted for screws made with rolled threads and upset heads, as the under-cut shoulder, shown in view *C*, Fig. 2, can be produced on the bolt in the upsetting operation. The process of assembling washers on screws is similar to that employed for nuts. In this case both the screws and washers are carried by magazine feeds to the assembling mechanism. The washers are deposited in a feed dial equipped with cam-actuated plungers. After each successive washer has been dropped into the pocket in a plunger, that plunger continues around, and the cam causes it to rise and pick the cap-screw out of a holding device at the base of the chute leading from the hopper. The plunger is then gradually withdrawn by the cam, and the screw and washer continue around to a point where they come in contact with a roller which forces or springs the washer into place on the shoulder under the head of the screw. Further rotation of the assembling head then brings the plunger and the assembled unit carried by it into the ejecting position, where it is dropped into a container.

This machine is adapted for use on screws from 1/4 to 1/2 inch in diameter and up to 5 inches in length. The production is 80,000 units in a ten-hour day.

Preheating Gears for Repairs by Oxwelding

In recent years, the oxy-acetylene method has been applied to an ever-increasing extent for economically repairing broken gears. A preheating furnace is usually dispensed with when putting new teeth in ordinary small gears. All the preheating necessary can usually be effected by local application of the blowpipe flame itself. This, however, applies to small gears only. Gears of larger size are best prepared for welding by thoroughly preheating them with a gas-fired preheating torch, or, if the gear is very large, by constructing a temporary heating furnace of firebrick using charcoal as the fuel. The preheating is very important in the case of large gears.

Many welders become so skilled in building up broken gear teeth that they are able to control the flow of the weld metal to such an extent that there is little machining to be done after the teeth have been completely built up. This is especially so with steel gears. When teeth are to be built up in cast-iron gears, carbon blocks are sometimes used to facilitate the control of the weld metal. Pieces of carbon are easily shaped with a file so as to form a mold on either side of the tooth to be built up. Carbon blocks are familiar welding accessories and may be obtained wherever welding supplies are sold. The large companies supplying welding equipment usually stand ready to give further advice.

Mechanical Engineers Discuss Shop Practice

Standards of Finish for Machined Surfaces and Present-Day Cutting Metals were among the Subjects Dealt with at the Annual Meeting of the American Society of Mechanical Engineers

AMONG the important papers presented before the annual meeting of the American Society of Mechanical Engineers held in New York early in December was a complete treatise, based on a great amount of research, on the subject of establishing definite standards by means of which the finish of machined surfaces may be designated. This paper was prepared by R. E. W. Harrison, engineering director of the Cincinnati Grinders, Inc., Cincinnati, Ohio.

Mr. Harrison's paper reviewed some of the defects of the present-day accepted methods for designating the finish of machined surfaces. Better finishes were advocated, and a method was proposed for establishing definite standards of finish. A finish calibrating instrument was also described. The author pointed out that the subject of longer useful life in mechanical equipment is closely interlocked with the means provided for obtaining a better finish. The means whereby surfaces with low initial wear can be obtained were indicated.

"Sizes and Tolerances for Metal Fits," a paper that was also based on a thorough investigation, was presented by C. R. Reiman, Kelly Press Division, American Type Founders Co., Elizabeth, N. J. This paper dealt with the advantages of standardization of tolerances in manufacturing practice; comparisons were made between the tolerances employed for different classes of fits in practice.

Present-day Metal Cutting Tools

One entire session of the meeting was devoted to papers dealing with the cutting tools employed at the present time in American industry. A. H. d'Arcambal, consulting metallurgist, Pratt & Whitney Co., Hartford, Conn., dealt with tool-steel tools. W. A. Becker and A. E. Gordon of the Haynes Stellite Co., Kokomo, Ind., and W. A. Wissler, metallurgist of the Union Carbide and Carbon Research Laboratories, Long Island City, N. Y., dealt with Stellite cutting tools, while L. J. St. Clair of the Carboloy Co. covered cemented tungsten carbide as applied to cutting tools. In each of these papers, the applications of the different cutting metals was brought out, emphasis being placed on the specific purposes for which each is most useful.

In the paper on tool-steel tools, for example (abstracted on page 377 of this number of MACHINERY), the factors that govern the life of metal-cutting tools made from carbon, alloy, and high-speed tool steels were discussed, particular stress being laid on the importance of the correct design of tools. The whole range of metal-cutting tools, including drills, reamers, dies, and milling cutters, was briefly reviewed. The important influence of cutting fluids or coolants on the life of the tool, as well as the necessity of employing proper grinding wheels, was covered in considerable detail.

The paper on Stellite cutting tools (see page 369) gave important details of several types of machining operations in which Stellite is being successfully used. In general, Stellite can be employed economically on cast iron, semi-steel, malleable iron, bronze, or similar metals, and on mild steel if the section is heavy and the tools rigidly held.

The paper on cemented tungsten-carbide tools briefly reviewed the characteristics of this new cutting material and pointed out some of the requirements that must be met in its use.

Apprentice Training in Industry

Harold S. Falk, vice-president and works manager of the Falk Corporation, Milwaukee, Wis., reviewed the apprentice training movement in Wisconsin, pointing out how apprentice training has made progress in that state because of the organized effort that has been made to advance it. Employers and employes have cooperated in the promotion and support of an apprenticeship law in the state which stabilizes and dignifies apprenticeship by preventing the exploitation of the apprentice and by setting standards of workmanship for the trades. There are at present 3350 apprentices in the state of Wisconsin.

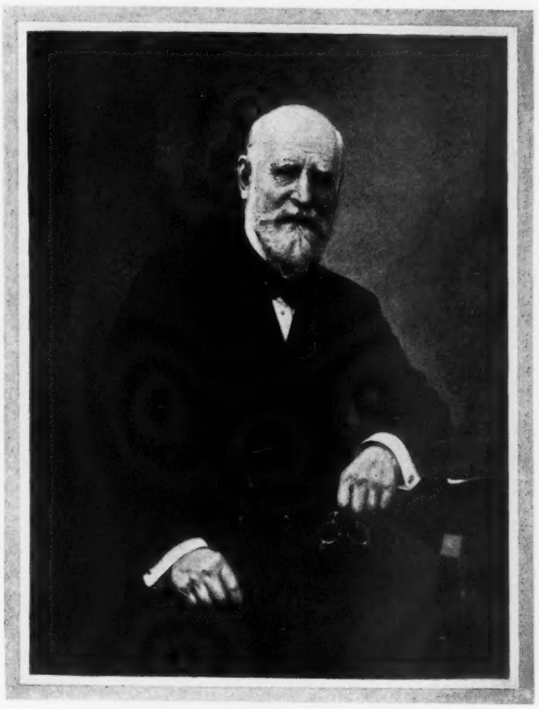
Safety in Industry—a Responsibility of Management

L. P. Alford, vice-president of the Ronald Press Co., in a paper entitled "Management's Responsibility for Industrial Accidents," pointed out that there has been a change in the answer to the question, "Who is responsible for industrial accidents?" In the early days of the safety movement, the workman was held responsible for whatever befell him. Now there are those who place by far the major part of the responsibility for industrial accidents on the management. Mr. Alford pointed out that, in one organization, it was found that 88 per cent of all accidents could have been prevented by the vigilance of the supervisory force. He also quoted from the Committee on Safety and Production of the American Engineering Council: "Maximum productivity is dependent upon the reduction of accidents to an irreducible minimum."

Fiftieth Anniversary of the Bullard Company

The fiftieth anniversary of the Bullard Company, Bridgeport, Conn., was celebrated recently at the company's plant by hanging in the main lobby of the new administration building a portrait of Edward Payson Bullard, the founder of the business. It was in 1880 that Mr. Bullard, the father of the men who are now the chief executives of the business, established what was then known as the Bridgeport Machine Tool Works. In 1894 this business was incorporated as the Bullard Machine Tool Co., and since 1929, it has been known as the Bullard Company.

Edward Payson Bullard was born in 1841. At the age of seventeen, he became an apprentice in the Whitins Machine Works, Whitinsville, Mass. Upon the completion of his apprenticeship, he entered the employ of Colt's Armory at Hartford, Conn., and later became connected with the Pratt & Whitney Co. of the same city.



A Portrait of Edward Payson Bullard, the Founder of the Bullard Company, which Hangs in the Main Lobby of the Company's Administration Building in Bridgeport

Mr. Bullard was a typical New Englander, alert and practical; he took advantage of every opportunity to increase his knowledge of mechanics, and soon became recognized for his ability in machine design. With this mechanical ability was coupled a keen appreciation of commercial matters; and shortly after the Civil War, he engaged in the selling of machinery and equipment obtained from an arsenal. He then entered into the merchandising end of the machinery business in which he continued until he decided

The Employes of the Bridgeport Machine Tool Works in 1887

that in order to obtain "the best piece of equipment for the job" he had to build it himself. This marked the beginning of his machine tool building enterprise.

Mr. Bullard began by building lathes designed and constructed with many improvements, and then entered upon the line of business which has ever since been identified with the Bullard name—the adaptation of the idea of the vertical boring mill principle to smaller machines of the vertical type having a wide range of adaptability and flexibility of tooling. The fundamental character of Mr. Bullard's ideas are evidenced by the fact that the same basic principles are included in the present Bullard production machines.

Mr. Bullard passed away in December, 1906, leaving the future of the enterprise to his sons, who, having been trained by him, have continued to carry on the business on the principles laid down by him. Under their administration, the unusual production problems of modern industry have been adequately met, the well-known "Mult-Au-Matic" being one of the evidences of this. There are now also prominent in the organization men of the third generation of the Bullard family.

Apart from its machine tool history, the Bullard Company has an interesting war record. The company built and equipped a plant for the manufacture of 155-millimeter guns of the French field model in record time. The production of guns was accomplished successfully by methods new in the gunmaking art, surpassing the efficiency of established arsenals. At the end of the war, the gun plant was taken over by the company, and today serves as its machine tool building plant.

* * *

CINCINNATI ENGINEERS MEET

Aeronautics was the chief subject discussed at a recent meeting of the Cincinnati section of the American Society of Mechanical Engineers. Glen Angle, vice-president and chief engineer of the R. K. LeBlond Aircraft Engine Co., Cincinnati, Ohio, made a comparison of present-day aircraft engine construction with that of a decade ago. It was formerly necessary to recondition engines after about 100 flying hours. Today they do not have to be overhauled until after from 200 to 300 hours of flying. The most marked improvements that are likely to be made in aircraft engines in the near future are in the materials used in construction.

John Paul Riddle, of the Embry-Riddle Co., Cincinnati, Ohio, predicted that airplanes capable of carrying more than twenty-five passengers with a speed of over 150 miles an hour will be employed regularly a few years from now. These larger planes will be served by feeder lines on which smaller planes are operated. It is likely that small parcels will be carried by air in greater volume than at the present time. In spite of the business depression during the past year, statistics show that there was a considerable growth in aviation throughout the United States.

THE S. O. B. V. CUTTING ALLOY

Our British correspondent furnishes us with some interesting information relating to the so-called S. O. B. V. cutting alloy, made by S. Osborn & Co., Ltd., Sheffield, England. This cutting alloy, the composition of which has not been made known, can be forged, annealed, and machined, and is not brittle. It is stated that it will turn and drill some very hard materials that have hitherto been considered unmachineable; for example, manganese steel, heat-treated nickel-chromium steel, and chilled cast iron are being machined with this new cutting alloy in everyday British practice.

On less hard materials, it is possible to machine at higher speeds, and with deeper cuts and heavier feeds, than has been formerly the practice. As an example of what is being done with this cutting alloy, it is mentioned that manganese steel is drilled at a speed of 10 peripheral feet per minute, with a feed of 0.004 to 0.008 inch per revolution. In turning manganese steel, a peripheral speed of about 12 feet per minute is employed, with a maximum feed of 1/32 inch per revolution and a depth of cut of 3/16 inch. In one instance, a manganese steel rail was drilled with a drill 3/4 inch in diameter, the holes being 3/4 inch deep. The drilling was performed in 3 1/2 minutes without a lubricant at a speed of 52 R.P.M. and a feed of 0.004 inch.

* * *

SIGNS OF BUSINESS IMPROVEMENT

On page 256 of December MACHINERY, we mentioned that it is encouraging to learn in this period of generally quiet business of concerns whose volume of business is satisfactory. The Millholland Sales & Engineering Co., Indianapolis, Ind., which company designs and builds automatic drilling machines and special production machines, writes us that the orders on hand will require the plant to operate on two eight-hour shifts six days a week through the first quarter of 1931. The company adopted two eight-hour shifts—one from 6:30 A.M. to 3 P.M. and one from 3 P.M. to 11:30 P.M.—as a temporary measure, half an hour being allowed for lunch during each shift. The results have proved so satisfactory that it is probable that this arrangement of working hours will become a permanent policy of the company.

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ELECTRIC PRECISION GAGE OF GREAT ACCURACY

In MACHINERY, February, 1930, page 435, a gage was described with an amplification factor of 10,000, making it possible to measure to an accuracy of 0.00005 inch, independent of the human touch. Numerous letters have been received asking where this gage might be obtained, and readers of MACHINERY will be interested in learning that this gage is now available on the market. It is manufactured and sold by the General Electric Co., Schenectady, N. Y.

Cleaning Scale and Rust from Steel Parts

A New Electrolytic Pickling Process that Leaves the Work Clean and Bright—Particularly Applicable in Plating and Galvanizing Shops

SCALE formed in rolling, forging, tempering, and annealing steel of any analysis can be removed by a "Bright Dip" electrolytic pickling process recently developed by the Hanson-Van Winkle-Munning Co., Matawan, N. J. Briefly, this process consists of treating the steel first as a cathode in an acid bath and then as an anode in a second acid bath, with a water rinse in between. While cathodic and anodic baths have been used separately in the past for removing scale and rust, it is believed by the concern that this is the first combined use of the two in which the work comes out bright.

Where the Process is Applicable

The process is particularly applicable in plating shops, since it greatly reduces the grinding and polishing otherwise required in order to obtain metal surfaces that will take plating satisfactorily. It is said that at least one polishing operation is eliminated by the process and that grinding wheels of finer grain can be employed. Consequently, the polishing time necessary for removing coarse abrasive marks is also reduced.

However, there are also wide applications of the process outside of plating or galvanizing shops, because whenever forgings, stampings, or deep-drawn parts are to be machined, the scale tends to dull the tools rapidly. This, of course, necessitates frequent tool grinding. Chattering of tools when they encounter heavy scale is destructive to machines, as is well known.

The Successive Steps Involved in the New Process

In this new method of cleaning scale and rust from steel parts, all grease is first removed by dipping the work for a few seconds into an electrolytic cleaning solution comprising six ounces of caustic cleaner to one gallon of water. Then, after a water rinse, the work is immersed as a cathode in the hot No. 1 bath, which is charged with an electric current of from 60 to 100 amperes per square foot. It remains in this bath long enough to reduce the oxides and leave a black residue composed principally of iron carbide.

After this bath, the work is immediately rinsed in water and is then immersed in the No. 2 bath as an anode, this bath being charged with electric current of 150 amperes per square foot. It is left in this bath until all the residue has been cleaned off and the metal surfaces are bright and chemically clean. Next it is subjected to an acid neutralizing dip in a hot sodium carbonate solution, which is followed by a hot water rinse. This completes the successive steps of the process.

One of the principal advantages claimed for this process is that the time required for the "Bright Dip" averages only about 10 per cent of the time taken in ordinary pickling. As a consequence, the new process speeds up production. Low acid consumption is another important advantage claimed. It has been found that the No. 1 bath can be used constantly for a week of 144 hours before it needs to be renewed and that the No. 2 bath can be used for a month. Another advantage is that the same solutions, with variations in the current and time of immersion, can be used for all classes of work.

Inhibitors are not necessary with this process, because the scale is so quickly attacked and reduced that the acids are not in contact with the metal long enough to cause an appreciable loss of metal. Practically no fumes are generated by the "Bright Dip" solutions.

Generally speaking, hydrogen embrittlement does not take place in this process except with highly tempered products of thin section, such as springs and hacksaw blades. However, work of this kind is embrittled in ordinary pickling. Although embrittlement cannot be prevented, it can be corrected by boiling the articles in water for a few minutes or by baking them in a moderately hot oven after pickling.

Another advantage pointed out for this electrolytic pickling method is that the amount of solution required is only about one-half of that used in ordinary pickling. Inasmuch as the pickling time is greatly reduced, the cost of labor is also lessened. Full-automatic or semi-automatic equipment can be obtained to reduce still further the labor cost.

It is pointed out that the complete removal of scale increases the machineability of the metal, which, of course, reduces tool maintenance costs. Inspection of metals for unpickled areas or imperfections can be quickly accomplished, since defects will show up clearly against the bright metal. A final advantage mentioned is that all metals treated by this process are chemically clean.

Time Required for the "Bright Dip"

The scale formed in heat-treating processes may be of two classes—the black magnetic oxide of iron (Fe_3O_4) or blue to brown oxide (Fe_2O_3). The first of these is the more difficult to remove in ordinary pickling solutions. It is generally removed in the "Bright Dip" in five minutes, but if the coating is unusually heavy, it will require a maximum of ten minutes in the No. 1 bath and two minutes in the No. 2 bath. The blue to brown oxide, which comprises the principal part of scale formed in annealing, tempering, and forging, and is usually light in

character, can be removed in not more than five minutes by the "Bright Dip" process.

Stainless Steel and Rustless Iron can be Cleaned

The complicated oxides formed on stainless steel and rustless iron can be removed by immersing the work for from five to six minutes in bath No. 1 and from one to two minutes in bath No. 2. Other alloys, such as chrome-vanadium and chrome-molybdenum steel, yield to treatment as readily as the stainless group.

Conduit pipe and other varieties of hot rolled or welded tubular products can be processed in from three to five minutes. However, oxides on these products often contain a certain amount of silica, which may require a somewhat longer time for removal. An interesting fact in connection with this class of work is that the scale is removed from the inside of tubes as well as from the outside, thus effecting a very thorough cleaning.

Where the "Bright Dip" Cannot be Used Effectively

The process cannot be used to advantage, as yet, on thin steel sheets or products made of fine steel, wire, or strip, or other products of thin section in which the temper plays an important part. This is due to the fact that the thickness of the sheet automatically governs the amount of current that it will carry.

Parts with deep recesses are sometimes treated with difficulty, and may require inside anodes for a thorough reduction and elimination of the scale. Steel, iron, or malleable iron castings cannot be treated, because the acid used will not attack and reduce the silica inclusions that form a heavy skin on the surface of sand castings.

Application has been made for a patent to cover this process, but the Hanson-Van Winkle-Munning Co. will license manufacturers to use the process in their own plants.

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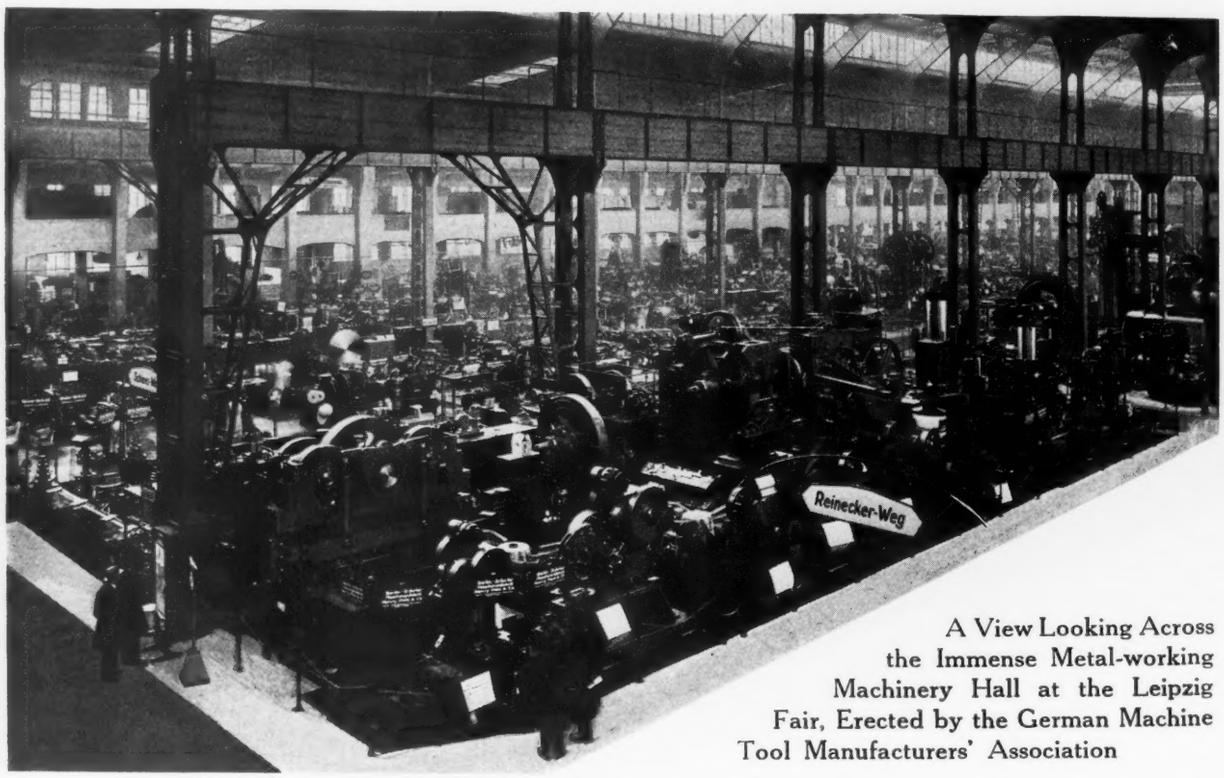
THE LEIPZIG FAIR IN 1931

The well-known Leipzig Fair will be held this year from March 1 to 7. The engineering, materials, and equipment divisions of the Fair will include the displays of 2231 manufacturers from all parts of the world. The exhibits of machines, apparatus, and materials will cover an area of 1,400,000 square feet, housed in seventeen halls, as well as out of doors. The largest single division of the machinery exhibits is that of machine tools; machinery and shop equipment of practically every description will be on exhibition. This exhibit is housed in an immense hall erected through the efforts of the German metal-working machinery manufacturers. The accompanying illustration shows a view in this hall from one of the former expositions. Further information concerning the Fair can be obtained by addressing the Leipzig Trade Fair, Inc., 11 W. 42nd St., New York City.



A View Looking Across the Immense Metal-working Machinery Hall at the Leipzig Fair, Erected by the German Machine Tool Manufacturers' Association

* * *

Ten years ago there was no radio industry. Today the value of the products of this industry amounts to approximately $375,000,000 annually. In 1929, there were produced 4,938,000 radio receiving tube sets and 3,300,000 loud speakers.

INDEXING MOVEMENTS FOR ANGLES—3

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
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1	15	47.3	..	..	8	57	1	45	39.1	..	..	9	46
1	17	8.5	7	49	7	49	1	45	52.9	..	..	10	51
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1	20	25.5	7	47	7	47	1	50	12.2	10	49	10	49
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1	21	49.0	5	33	10	66	1	51	43.4	6	29	12	58
1	22	10.4	..	..	7	46	1	52	4.5	..	..	11	53
1	22	22.3	..	..	9	59	1	52	30.0	..	..	5	24
1	23	4.6	6	39	6	39	1	53	1.4	9	43	9	43
1	23	47.5	..	..	9	58	1	53	13.5	..	..	13	62
1	24	42.3	..	..	8	51	1	53	41.0	4	19	12	57
1	25	15.7	3	19	9	57	1	54	32.7	7	33	14	66
1	26	24.0	..	..	4	25	1	54	53.6	10	47	10	47
1	27	5.8	5	31	10	62	1	55	42.8	..	..	9	42
1	27	34.0	6	37	6	37	1	56	28.2	..	..	11	51
1	27	54.4	7	43	7	43	1	56	45.4	8	37	8	37
1	28	9.8	8	49	8	49	1	57	23.4	5	23	10	46
1	30	0	3	18	9	54	1	58	32.2	9	41	9	41
1	31	31.5	..	..	10	59	1	58	58.9	..	..	13	59
1	31	41.8	..	..	9	53	2	0	0	4	18	12	54
1	31	54.9	8	47	8	47	2	1	2.0	..	..	13	58
1	32	11.7	7	41	7	41	2	1	13.4	11	49	11	49
1	33	6.2	5	29	10	58	2	1	56.1	7	31	14	62
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1	35	17.6	3	17	9	51	2	3	9.4	..	..	13	57
1	35	48.3	..	..	11	62	2	4	36.9	9	39	9	39
1	36	25.7	..	..	5	28	2	5	34.8	10	43	10	43
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1	38	10.9	6	33	12	66	2	6	23.0	11	47	11	47
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1	40	40.6	..	..	11	59	2	9	7.8	..	..	11	46
1	41	15.0	3	16	..	..	2	9	36.0	..	..	6	25
1	41	53.2	..	..	10	53	2	10	0	..	..	13	54
1	42	9.7	7	37	7	37	2	10	20.6	7	29	14	58
1	42	24.8	..	..	11	58	2	10	38.7	..	..	15	62
1	42	51.4	4	21	8	42	2	10	54.5	8	33	16	66

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INDEXING MOVEMENTS FOR ANGLES—4

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
2	11	21.0	9	37	9	37	2	40	51.0	14	47	14	47
2	11	42.4	10	41	10	41	2	41	3.1	..	..	17	57
2	12	14.7	12	49	12	49	2	42	0	6	20	9	30
2	12	27.1	..	..	13	53	2	43	1.1	..	..	16	53
2	12	37.9	..	..	14	57	2	43	15.3	13	43	13	43
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2	17	17.2	..	..	15	59	2	44	20.8	7	23	14	46
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2	18	27.6	10	39	10	39	2	46	9.2	12	39	12	39
2	19	5.4	..	..	17	66	2	47	8.5	..	..	13	42
2	19	21.2	8	31	16	62	2	47	35.1	9	29	18	58
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2	22	6.3	5	19	15	57	2	51	13.1	13	41	13	41
2	22	38.4	..	..	14	53	2	51	49.0	..	..	21	66
2	22	56.4	..	..	9	34	2	52	20.4	15	47	15	47
2	23	15.9	13	49	13	49	2	52	48.0	..	..	8	25
2	24	0	4	15	8	30	2	53	12.4	..	..	17	53
2	24	52.6	11	41	11	41	2	53	34.2	..	..	9	28
2	25	56.7	10	37	10	37	2	53	53.8	..	..	19	59
2	26	26.4	..	..	16	59	2	54	11.6	10	31	20	62
2	27	16.3	9	33	18	66	2	54	42.3	..	..	11	34
2	28	3.8	..	..	17	62	2	55	8.1	12	37	12	37
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2	28	57.9	8	29	16	58	2	56	5.2	..	..	15	46
2	29	21.7	13	47	13	47	2	56	19.6	16	49	16	49
2	30	0	5	18	15	54	2	56	53.7	..	..	19	58
2	30	41.8	12	43	12	43	3	0	0	6	18	18	54
2	31	12.0	..	..	7	25	3	2	54.1	..	..	21	62
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2	32	36.5	..	..	13	46	3	3	49.7	16	47	16	47
2	32	49.8	..	..	15	53	3	4	23.4	14	41	14	41
2	34	17.1	14	49	14	49	3	4	44.2	..	..	13	38
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2	35	35.5	..	..	17	59	3	7	20.8	17	49	17	49
2	36	18.9	..	..	11	38	3	7	49.5	8	23	16	46
2	36	46.4	9	31	18	62	3	8	10.9	..	..	23	66
2	37	30.0	..	..	7	24	3	8	22.3	15	43	15	43
2	38	2.9	12	41	12	41	3	9	0	7	20	..	..
2	38	16.5	..	..	17	58	3	9	28.4	..	..	20	57
2	38	49.4	5	17	15	51	3	9	43.7	13	37	13	37
2	40	0	8	27	16	54	3	10	0	..	..	19	54
2	40	32.4	11	37	11	37	3	10	35.3	6	17	18	51

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Composition and Treatment of Tool-steel Cutting Tools

While Many New Cutting Metals Have Been Developed During Recent Years, Carbon and High-speed Steels are Still the Materials Most Commonly Used for the Bulk of the Metal-cutting Tools Employed in Industry

IN a paper on "Tool-steel Tools," read before the annual meeting of the American Society of Mechanical Engineers by A. H. d'Arcambal of the Pratt & Whitney Co., Hartford, Conn., the composition of carbon and high-speed steels used for metal-cutting tools was given. The plain carbon tool steel now most commonly used for metal-cutting tools is composed of from 1.10 to 1.20 per cent carbon, and a maximum of 0.30 per cent manganese, 0.02 per cent phosphorus, 0.02 per cent sulphur, and 0.30 per cent silicon.

The kinds of alloy carbon tool steels most commonly used at present for metal-cutting tools are given in the accompanying table. The numbers given in the first column are for identification in this article only, and are not trade designations. Alloy steel No. 1 is excellent for tools that usually fail by breaking. This steel is recommended for so-called "shock tools." Steel No. 2 is used for tools when a slightly greater depth of hardening than can be obtained with plain carbon tool steel is desired.

The alloy carbon steels Nos. 3, 4, and 5 are commonly known as oil-hardening, non-deforming steels. Tools in which the minimum change in size during hardening is desired are made from steels of this composition. Experience has shown, however, that the usual types of water-hardening tool steels stand up better in service than the oil-hardening brands.

Composition of High-speed Steel for Metal-cutting Tools

The great majority of high-speed steel metal-cutting tools used at present are made from a high-speed steel containing 0.70 per cent of carbon, 4.0 per cent of chromium, 1.0 per cent of vanadium, and 18 per cent of tungsten. This kind of steel is the easiest to harden of all the different kinds of high-speed steels offered to the trade. Tools made from it give satisfactory service when used under normal conditions, regardless of the type of material being machined. There has been an increasing demand during the last two or three years, however, for 18 per cent tungsten high-speed steel containing from 5 to 10 per cent cobalt, especially for use in lathe tools, boring tools, and tool bits. Tools made from this cobalt steel must be ground all over after the hardening operation on account of the deep soft skin produced in hardening. Turning tools made of this high-cobalt high-speed steel give excellent service on all kinds of materials, but especially on heat-treated alloy steels and other materials that are difficult to machine.

Composition of Steels for Specific Purposes

There continues to be a slight demand for the so-called low-tungsten, high-vanadium type of high-speed steel (13 per cent tungsten, 2 per cent vanadium), especially for turning tools of various types. This steel is considerably more difficult to harden properly than the more commonly used 18 per cent tungsten material, and its general use is therefore somewhat restricted.

The high-carbon, high-chromium type of steel is being used to a great extent today for blanking and lamination dies, as well as for parts where resistance to wear is of primary importance. This material contains from 1 1/2 to 2 1/4 per cent carbon and 11 to 13 per cent chromium. This high-chromium alloy does not possess the thoughness, red hardness properties, and cutting qualities of high-speed steel, and is not recommended as a substitute for high-speed steel for metal-cutting tools.

Practically all carbon, alloy, and high-speed tool steels are melted today by the electric-furnace process, using the Heroult three-electrode type furnace. Ten years ago the crucible process was the one employed by the mills in this country for melting these high-grade steels. It is the opinion of the author that the electric-furnace-melted material is of a uniformly higher quality than the crucible-melted steel, this being especially noticeable in the alloy and high-speed tool-steel types.

From time to time, the small-tool manufacturer is requested to furnish semi-high-speed steel tools. A careful study of a large number of the various types of steels introduced by the steel companies during the last few years shows no steel possessing the necessary properties for this purpose. Just because a low-tungsten steel tool (1 1/2 to 2 per cent tungsten) gives a red spark when touched to the grinding wheel is no reason for expecting the tool to have high-speed steel properties. In fact, tools made from this low-tungsten tool steel cannot be run at any higher speeds or feeds than plain carbon-steel tools, and do not possess as great toughness.

Incoming shipments of tool steel should be given a careful microscopic inspection. A lot of steel may be of the correct chemical composition, have the proper hardness, and possess a satisfactory fracture after the standard hardening treatment, but unless the structure as revealed by the micro-

scope at magnifications from 100 to 1000 times is satisfactory, tools made from this material will not give good results.

Hardening-room Equipment

The hardening room of a small-tool plant is one of the most important departments in the factory. Expense should not be spared in equipping this department with the best types of hardening and drawing furnaces, pyrometers, and quenching baths. All furnaces should be provided with automatic temperature control, time clocks for each operator should be furnished, quenching baths should be maintained at the correct temperature through efficient cooling systems, and all pyrometers should be checked frequently against master instruments. Proper hardening instructions should accompany each order of tools, these instructions preferably being issued by the metallurgical department. Guesswork by the man at the fire thus is done away with. After hardening and drawing, the tools should be checked carefully for hardness, using special files provided for this purpose in conjunction with a Rockwell hardness tester.

The lead bath is used by most manufacturers in connection with the hardening of carbon-steel tools such as taps, dies, drills, and reamers. The temperature used varies from 1440 to 1500 degrees F., brine being the quenching medium most commonly employed. The oil bath, salt bath, or oven-type furnace may be used for the tempering of the tools after the quenching operation.

Hardening High-speed Steel Tools

High-speed steel tools of the 18 per cent tungsten type should be hardened as follows: They should be preheated to a temperature of 1500 to 1600 degrees F. and then transferred to the high-temperature furnace, the temperature of which is approximately 2350 degrees F. As soon as the tool reaches the furnace temperature, it should be quenched in oil.

Drawing should be from 1050 to 1200 degrees F., depending upon the type of tool, and then the tool should be air cooled. High-speed steels containing cobalt must be quenched from a temperature of approximately 2400 degrees F. to obtain the most satisfactory results.

High-speed steel containing the proper percentage of carbon and quenched from 2350 degrees F. will show the same hardness after a 1050 degrees F. draw as in the undrawn condition. But considering that high-speed steel tools properly hardened and high drawn possess twice the strength of tools in the undrawn state, without any loss of hardness, it is the practice of most manufacturers to give all high-speed tools the high-draw treatment. It is important that high-speed steel tools be heated to a temperature in excess of 2300 degrees F. when open-fire hardened, as the cutting efficiency of a high-speed tool increases with increased hardening temperature up to the temperature where slight coarsening of the grain takes place.

Grinding of Tool-steel Tools

A few years ago an article appeared in one of the trade journals in which the statement was made that more tools are spoiled in the grinding operation than during hardening. While this statement is somewhat exaggerated, it is true that many tools are ruined by improper grinding. The use of too hard a wheel or a loaded wheel and improper cooling during the grinding operation are contributing factors to grinding checks, soft skin, and similar defects. It is more economical to use a few additional wheels of the proper grain and grade monthly than to attempt to economize through the use of harder wheels.

In connection with the grinding of high-speed steel tools, a few grinding-room foremen share the opinion that a straw or blue color appearing on the tool after the grinding operation will not affect the performance of the tool, considering that the tool has passed through that range when being high drawn. While it is true that 1100 degrees F. is a much higher drawing temperature than the blue color would indicate, frequently a high-speed tool showing color after the grinding operation can be filed readily along the cutting edges. This means that the cutting edges of the tools were heated to a temperature in excess of 1100 degrees F. during the grinding operation, thus ruining the tool.

Cutting Fluids Materially Influence the Results Obtained from Steel Tools

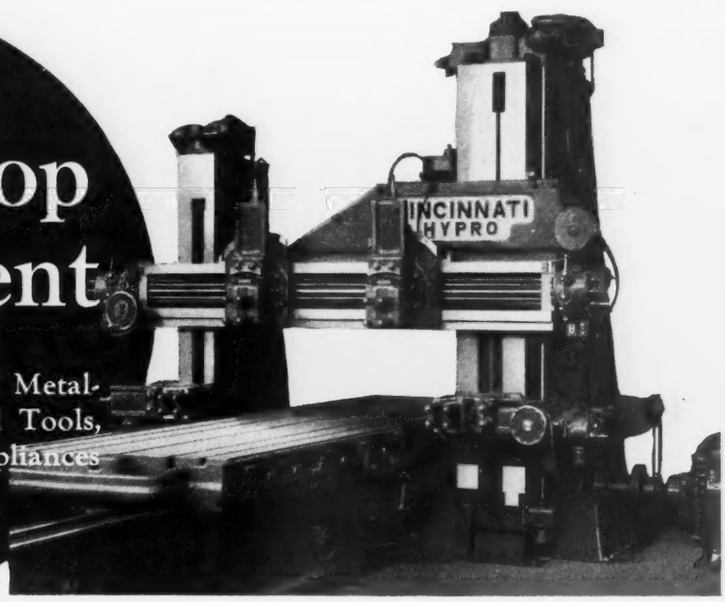
The failure of many metal-cutting tools is due to the coolant used. Some machining operations, such as threading and milling, require a good grade of sulphur-base oil as the cutting fluid; other types of jobs, a soluble oil; some special operations call for pure lard oil; aluminum-alloy jobs, kerosene plus a small amount of machine oil. A generous flow of the cutting fluid should be directed on the work at all times. The kind of cutting fluid used not only affects the life of the tool, but also has an important bearing on the finish obtained.

Composition of Alloy Carbon Tool Steels

No.	Carbon, Per Cent	Manganese, Per Cent	Phosphorus, Per Cent Maximum	Sulphur, Per Cent Maximum	Silicon, Per Cent Maximum	Chromium, Per Cent	Vanadium, Per Cent	Tungsten, Per Cent
1	1.05—1.15	0.30 max.	0.020	0.020	0.25	None	0.15—0.20	None
2	1.10—1.20	0.30 max.	0.020	0.020	0.25	0.40—0.60	None	None
3	0.85—0.95	1.20—1.40	0.020	0.020	0.25	0.40—0.60	None	0.40—0.60
4	0.85—0.95	1.60—1.80	0.020	0.020	0.25	None	None	None
5	0.85—0.95	1.60—1.80	0.020	0.020	0.25	None	0.15—0.25	None

New Shop Equipment

Latest Developments in Metal-working Machines, Small Tools, and Work-handling Appliances

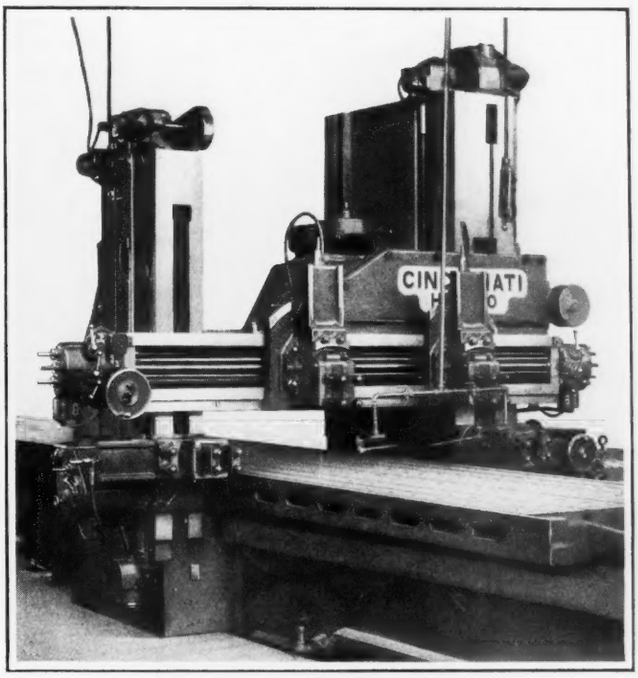


CINCINNATI OPEN-SIDE PLANER WITH REMOVABLE LEFT-HAND HOUSING

Pneumatic tool lifters which raise the tools clear of the work on the return stroke of the table are one of the important new features of a Hypro open-side planer recently built by the Cincinnati Planer Co., Cincinnati, Ohio. These pneumatic tool lifters are particularly advantageous when tungsten-carbide tools are used. They can be used simultaneously on all heads or on any one head, and are made without projecting parts or lugs that might interfere when working in close quarters. All moving parts of the lifters are hardened and ground to assure long service life.

This machine is now operated completely through push-button controls. The rail and knee are clamped to the column by an electric clamp which is operated by a torque motor when a push-button at either end of the rail is pressed. A push-button is also pressed for raising and lowering the rail and for rapidly traversing the rail- and side-heads.

The left-hand housing is auxiliary equipment which permits the use of a fourth head when required. This housing is provided with a separate small motor for rapidly traversing its head. The entire housing, with the head, can be removed in a few minutes when a wider piece of work is to be machined than can be accommodated with the housing assembled. This can be done without changing any of the electrical connections of the machine.



Hypro Open-side Planer with a Fourth Head on a Removable Housing

Coolant supplied to the tools drains to the left-hand side of the table and then through a short pipe to a steel trough, which runs along the side of the bed, as shown in the illustration. This trough, in turn, drains into a tank at the rear of the left-hand housing, where a small pump and motor are mounted. The piping for the coolant is fitted with universal joints, so that the fluid can be delivered to the tools regardless of their positions.

The shifting device is designed to permit a short table stroke of from 1 1/2 to 2 inches to be employed, depending on the type of reversing motor used. This feature has many advantages when machining in close quarters on the inside of a casting. Small dogs are furnished on the table between the regular shifter dogs for speeding up the table movement over gaps between the parts being planed.

The handwheel at the left-hand side of the rail is part of the built-in indexing device provided for use in rack cutting and spacing. There is an electric speedometer on one side of the right-hand column which registers the table speed, during both the cutting and return strokes.

OLSEN-LUNDGREN DYNAMIC BALANCING MACHINE OF SEMI-AUTOMATIC PUSH-BUTTON CONTROL TYPE

One of the exhibits of the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., at the recent Power Show in New York City, was a new dynamic balancing machine of the electric-spark type, provided with a semi-automatic push-button control. Long crankshafts or other parts requiring more than two supports can be handled efficiently by this machine. The No. 3 size machine displayed is graduated to show unbalance of parts in increments of 0.05 ounce-inch, and much closer amounts can be readily approximated. The machine is shown in the illustration set up for determining the location and amount of dynamic unbalance in an eight-cylinder automobile crankshaft.

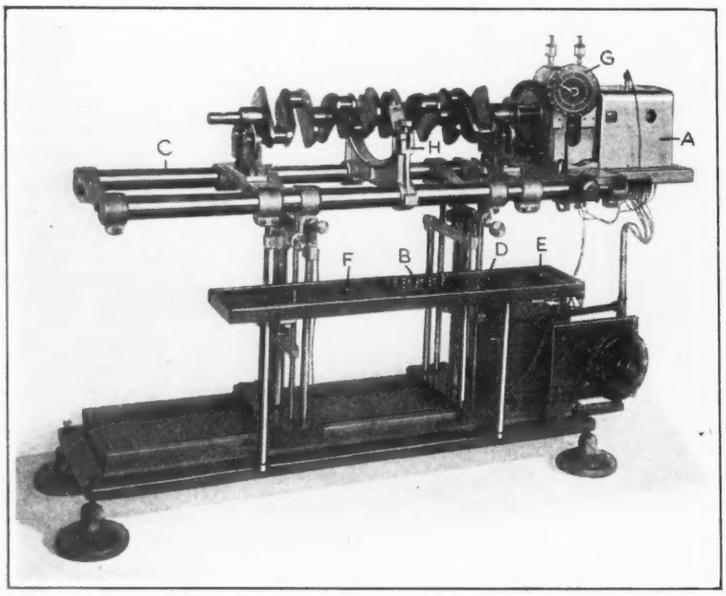
This machine is based on the same principle as the machine described in February, 1928, MACHINERY, page 466, but important changes have been made to make it more adaptable for some classes of work. The most important changes include a new type of vibrating frame *C*, which supports the entire work, and the use of a compensating weight directly on this frame for determining the amount and angular position of unbalance. Steady-rest *H* prevents errors due to eccentricity or deflection of the crankshaft during the balancing operation. The main supports and pivots of the vibrating frame may be placed in any relation to the two planes of correction.

The compensating weight and its mechanism are enclosed in housing *A*. This weight is shifted in a graduated holder to compensate for the amount of unbalance in the end of the crankshaft being checked. Shifting of the weight is accomplished by depressing either of the two right-hand switch buttons of group *B* while the machine is running.

Before the weight is shifted, however, the weight-holder is first swiveled on its rotating arbor, so as to bring the weight into the same angular plane as the unbalance or in the opposite plane. The plane depends upon whether the unbalance in the crankshaft and the compensating weight are on the same or opposite sides of the pivot. Swiveling of the weight-holder on its arbor is effected by depressing either of the two left-hand buttons of group *B* while the machine is running. For determining the unbalance, the crankshafts are revolved at a constant speed of 250 revolutions per minute.

After an unbalanced crankshaft has been placed on the rolls of the vibrating frame, it is connected to the drive head through a flexible coupling, and the frame is locked about a pivot at the left-hand end to permit a reading for the right-hand end correction to be taken. Then when the crankshaft is rotated with switch *D* closed, any unbalance will cause an electric spark to jump from the rotating indicator of dial *G* to the graduated metal circle near the periphery of this dial. The indicator turns at the same speed as the work. By observing the degree graduations on the dial between which sparks appear, the angular plane of unbalance can be determined.

Switch *D* is now opened and switch *E* closed for determining the angular plane of the compensating weight-holder previously referred to. The weight-holder is next swung into the same plane as the unbalance by depressing either of the two left-hand buttons of group *B*, as already explained. The machine is then operated with switch *D* closed and switch *E* opened, and the two right-hand buttons of group *B* are alternately depressed until the weight has been



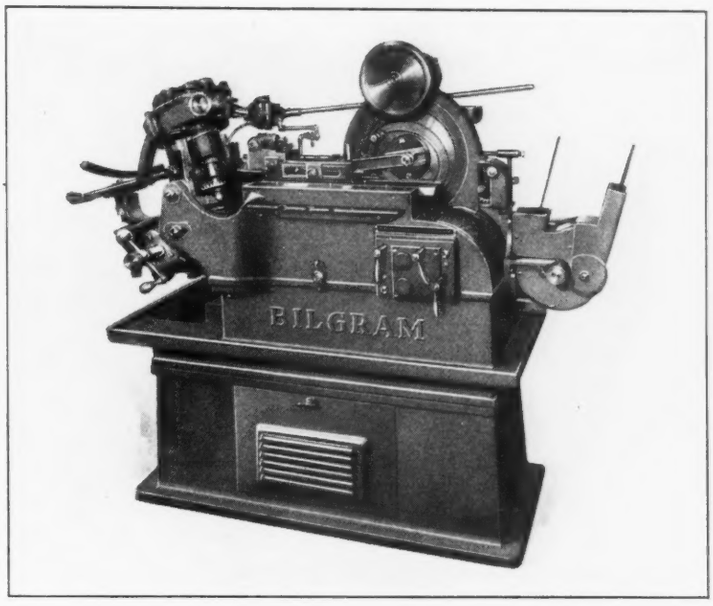
Olsen-Lundgren Electric-spark Balancing Machine for Long Parts Requiring More than Two Supports

moved to compensate for the unbalance, when the sparking ceases.

The machine is now stopped with a center mark in one end of the weight-holder directly in line with a wire stretched across the round window in the front of housing *A*. With the crankshaft in this position, the mass causing the unbalance is toward the front of the machine and in the same horizontal plane as the axis of the crankshaft. A mark is then made on the crankshaft in this plane, near the right-hand end where one correction is to be made. The amount of unbalance in ounce-inches is now determined from the graduations on the weight-holder.

A reading for the left-hand correction is next taken with the left-hand end of the frame *C* free and with the frame vibrating about a fixed pivot at the right-hand end. Buttons *F* and *E* are used in the same way that buttons *D* and *E* were employed in obtaining the reading for the correction of the right-hand end.

When the machine is to be used for production service, the output may be greatly increased by using charts that show the amount of metal to be removed to correct any unbalance.



Bilgram Bevel Gear Generator which Cuts Teeth of Straight and "Spiraloid" Types

BILGRAM STRAIGHT AND "SPIRALOID" BEVEL GEAR GENERATOR

Bevel gears with either straight or Spiraloid teeth can be produced in an improved generating type of machine recently brought out in a 6-inch size by the Bilgram Machine Works, 1217-35 Spring Garden St., Philadelphia, Pa. Only about five minutes is required to change the machine over to suit the cutting of either type of teeth. A belt-driven model of the machine is shown in the illustration; in the motor-driven type, the motor is located in the base.

An important feature of this machine is that only one set of three tools is required for cutting bevel gears of any pitch within the range of the machine. Teeth of any diametral pitch (or any fractional diametral pitch) up to five can be cut in steel, while teeth of any circular pitch up to one inch can be cut in cast iron. Cutters that have been removed for sharpening can be replaced within two minutes.

Gears are cut by this machine from solid blanks without a preliminary roughing. It is claimed that teeth of unusual accuracy are produced because of the gears being indexed for the next tooth during every return stroke of the tool. As evidence of this accuracy, it is mentioned that gears cut in this type of machine are being used in more than 30,000 Vitaphone machines, where uniform action and quietness are essential.

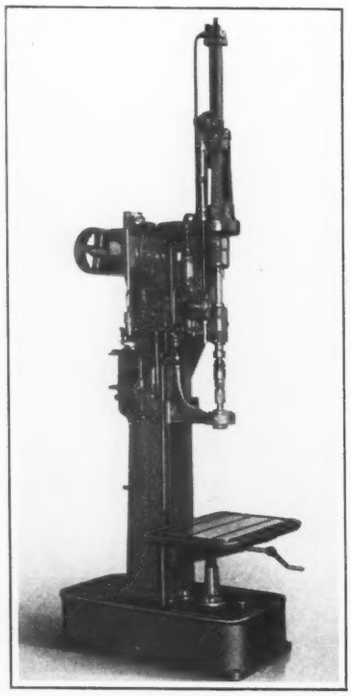
Eight different speeds of operation are obtainable through the use of quick-change gears. The net weight of the belt-driven machine is 2740 pounds.

BARNES DRILL CO.'S SINGLE-SPINDLE HONING MACHINE

Cylindrical holes from 1 to 4 inches in diameter can be honed on a No. 204 single-spindle honing machine recently developed by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. The regular spindle stroke of this machine is from 1 to 12 inches, but a longer travel can be provided. Pick-off gears can be furnished to give spindle speeds of from 69 to 618 revolutions per minute, while the rate of reciprocation can be varied from 1 inch to 50 feet per minute.

An Oilgear pump and special valve control provide automatic spindle reciprocation. The cycles of reciprocation may be changed while the unit is running. The length of stroke may be set by means of quickly adjustable stops to obtain just the right amount of hone over-run at each end of the cylinder being finished. This feature is important in preventing bellmouths and barrel shapes and in honing away tapers. The stroke control rod may be used at will to obtain short strokes at any point in the hone travel.

The hydraulic cylinder is superimposed directly over the spindle and the piston is connected to the spindle by a ball-



Barnes All-geared Honing Machine for Cylinders from 1 to 4 Inches in Diameter

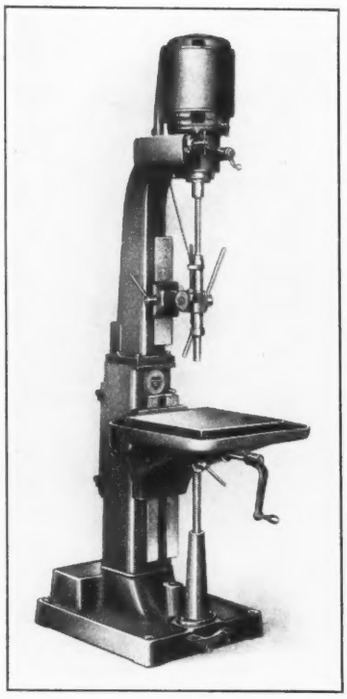


Fig. 1. Leland-Gifford Drilling Machine with All Wiring and Electrical Connections Enclosed

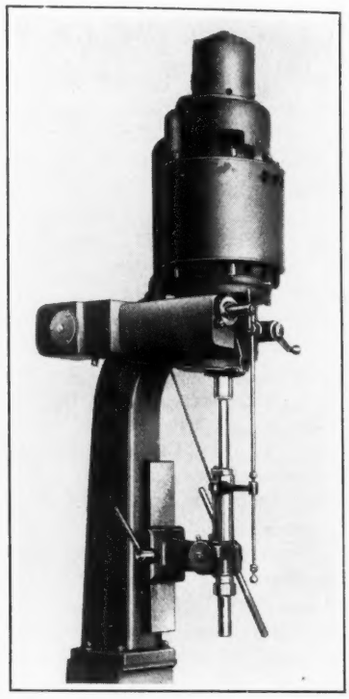


Fig. 2. A Reversing Switch and Motor-driven Blower are Provided for Tapping Operations

bearing coupling. The machine clutch lever on the left-hand side of the head is so arranged that when it is pulled downward it engages a multiple disk clutch and opens the hydraulic valve, thus simultaneously starting rotation and reciprocation. An upward movement of the lever stops the machine. There is a latch on the lever that provides hand control of the vertical spindle travel without engaging the clutch. Thus the spindle can be brought to or lifted from the work without rotating, it being essential that the spindle does not revolve while the hone is collapsed.

An air-operated table can be provided when the 12-inch stroke is not sufficient to permit lifting the hone out of the work. Auxiliary heads having two or more spindles can be attached to the sleeve if provided with a flange. The height of the regular machine to the extreme top is approximately 11 feet; the distance from the center of the spindle to the column is 10 1/4 inches; and the net weight of the pulley-driven machine is 1530 pounds.

LELAND-GIFFORD DRILLING MACHINE WITH ENCLOSED WIRING

All the wiring and electrical connections in an improved motor-spindle drilling machine recently placed on the market by the Leland-Gifford Co., Worcester, Mass., are enclosed within the column of the machine and thus thoroughly protected from damage due to moving parts. Greater safety, a neater appearance, and convenience are additional advantages.

To operate this machine, whether of the single-spindle type shown in Fig. 1 or the multiple-spindle type illustrated in Fig. 3, it is only necessary to run one set of wires from the alternating-current power line through a convenient hand-hole in the machine column and connect these wires to a fuse block placed just ahead of a magnetic contactor. This magnetic contactor is operated by means of the foot-treadle at the front of the machine. Through the treadle, all spindles can be started or stopped instantly by merely applying a slight foot pressure.

Four open motor speeds are obtainable instantly by means of a drum-type controller placed on the side of the head just below the motor (beside each motor in the case of a multiple-spindle machine) and operated from the front of the machine. Four other speeds are available through a ball-bearing back-gear unit provided for in the machine design. These back-gears are engaged and disengaged by a crank-handle next to the controller handle. An automatic interlock between this handle and the controller handle prevents engagement or disengagement of the back-gears when the controller is in the "off" position.

A reversing motor is provided for tapping operations. Reversal of the motor is accomplished by means of a reversing switch developed by the company, which is operated automatically by the up and down movement of the spindle. Forced ventilation through a motor-driven blower unit keeps the temperature of the drive

motor at a normal operating point. In Fig. 2 this blower unit is shown assembled on the drive motor.

Coolant is supplied to the cutting tools by a motor-driven pump unit mounted at the rear of the column just above the tank, which is cast integral with the base. The coolant is carried to the tools through pipes which are concealed within the column and have outlets at each spindle.

The regular Leland-Gifford semi-automatic return power feed can be applied, and all machines are so arranged that attachments, such as power feeds, back-gears, and pump units, if not originally supplied with the machine, can be readily applied in the user's shop by the use of a wrench and screwdriver.

This machine is manufactured in three sizes, taking drills from the smallest wire sizes up to 1 1/4 inches in diameter. Spindle speeds up to 10,800 revolutions per minute can be arranged for.

VERSON ALL-STEEL INCLINED PRESSES

Presses of the overhanging, permanently inclined type have been added to the line of Verson all-steel presses built by the La Salle Machine Works, Inc., 3013-17 S. La Salle St., Chicago, Ill. As in the case of the straight-side and inclinable types made by the company, these inclined presses are constructed of rolled-steel plates which have been cut to size and shape by the acetylene torch and then arc-welded into units. The frame, ram, and gears are all constructed in this manner.

The press illustrated is of 250 tons capacity, has an 8 1/2-inch crankshaft, and a throat depth of 14 inches. The stroke is 10 inches. The back-shaft runs in Timken tapered roller bearings and the flywheel and flywheel support are also provided with bearings of this type. Annular ball bearings are furnished in the pinion support.

The roller-bearing multiple-disk friction clutch is equipped with an automatic safety stop designed to disengage the clutch at the top of the stroke. An auxiliary hand-lever device provides for disengaging the clutch instantly at any point of the stroke. When the clutch is disengaged, the flywheel is the only moving part of the press, a feature that tends toward quieter operation. The motor drives through Texropes. Lubrication of working parts is effected through a one-shot fluid grease system.

CHISHOLM-MOORE ELECTRIC HOISTS

Twin hooks and load chains are provided on an electric chain hoist recently placed on the market by the Chisholm-Moore Hoist Corporation, 5000 Fremont Ave., Tonawanda, N. Y., for such work as handling bar steel, automobile

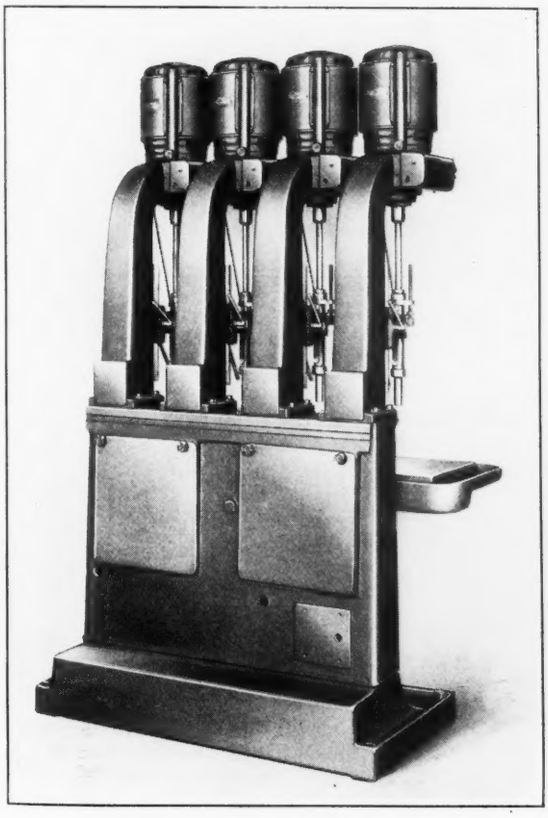
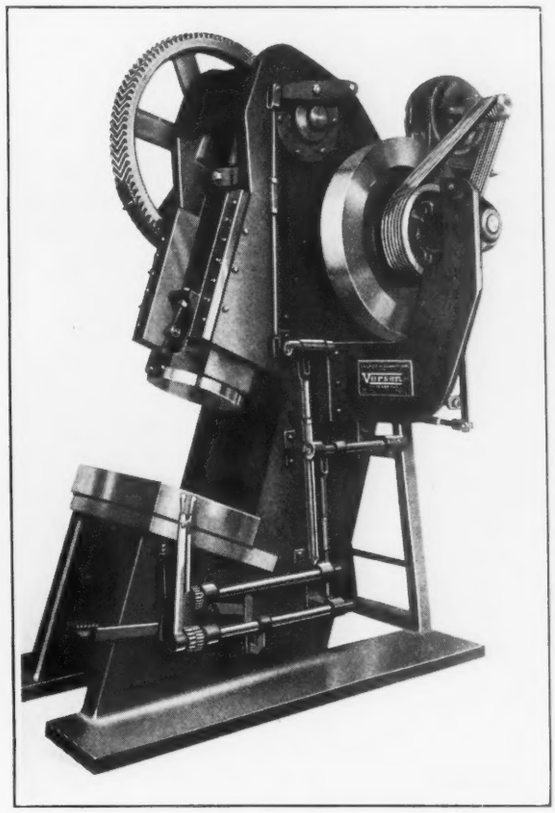


Fig. 3. Rear View of a Leland-Gifford Four-spindle Drilling Machine



Verson Permanently Inclined Press Made up of Steel Plates Welded Together

bodies, etc. This hoist, which is known as the Cyclone, is made in capacities ranging from 1/2 to 3 tons, inclusive, the distance between the load chains varying from 3 to 15 feet. Conveyors can be attached to the hoist frame to receive the slack chain and keep it from touching the object being lifted.

Safety devices stop the hoist operation when the hooks reach either the highest or lowest position, a magnetic brake instantly shutting off the current and preventing drifting of the load. Each hoist mechanism is equipped with eight ball bearings and four roller bearings. The ball-bearing motor is fully enclosed.

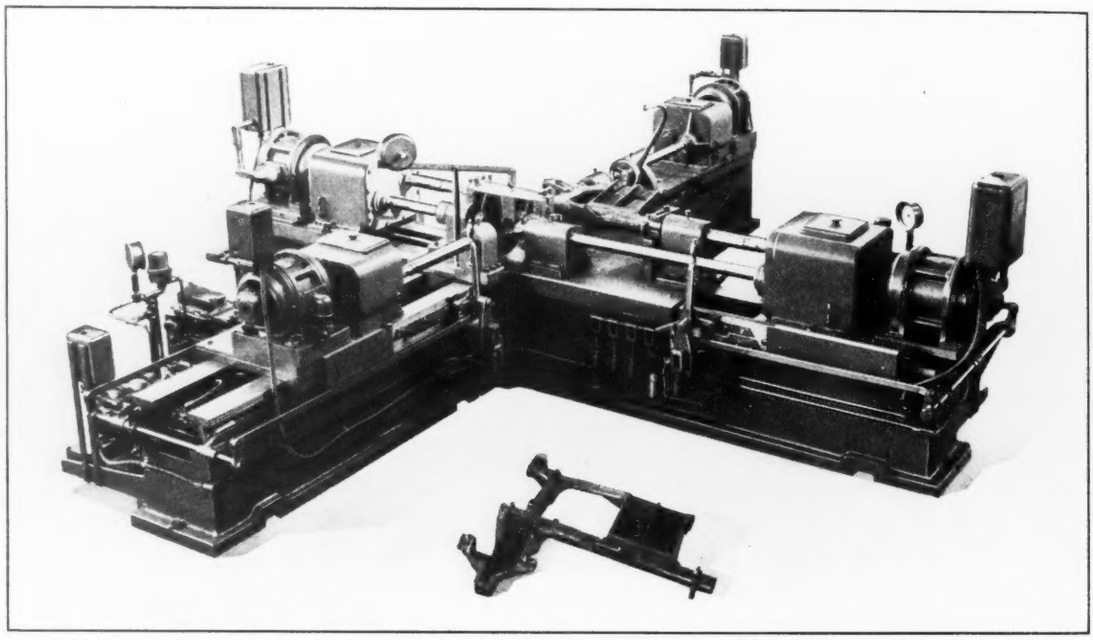
A wire-rope electric hoist that can be used when the head room is extremely low has also been brought out by this concern. The design of this "Hi-Up" hoist is very compact, the 1/4-ton hoist measuring only 13 inches in depth from the bottom of the runway beam to the bearing point of the lower hoisting hook. This hoist is supplied with either a lug suspension for stationary mounting or a ball-bearing push-type trolley. The rotating parts are mounted on Hyatt roller bearings.

DEFIANCE FOUR-WAY BORING AND FACING MACHINE

A four-way horizontal machine designed for boring and facing holes positioned at right angles to each other in a casting for agricultural equipment was recently built by the Defiance Machine Works, Defiance, Ohio. This machine, as shown in the illustration, is provided with a base made up of three sections that are doweled and bolted together. Four multiple-spindle heads are mounted at right angles to each other on ways on the base. These heads are enclosed and are continuously oiled by a force-feed system. There is a direct-connected motor drive to each head.

The work fixture is removable and is equipped with guide bushings for the boring-bars. Quick-acting adjustable screws and clamps are employed for holding the casting in position. One man loads and unloads the castings and operates the machine from in front, all push-buttons, starters for the motors and control levers for the feed being conveniently located.

Two Oilgear pumps and cylinders provide the feed for the heads. The arrangement is such that one pump drives each set of two opposed heads. This enables each set of heads to be operated independently and at any rate of feed, with a dwell for the facing cuts and a rapid return to an automatic kick-off or stop. With this equipment, twelve parts are bored and faced on all four sides per hour.



Defiance Four-way Boring and Facing Machine with Oilgear Feed for the Heads

BRADFORD TWO-HEAD DRILLING AND REAMING MACHINE

A special machine with two heads arranged vertically has been developed by the Bradford Machine Tool Co., 659 Evans St., Cincinnati, Ohio, for operation on an electric refrigerator part. The tooling equipment includes six work-holding fixtures mounted on a hand-operated turret. These fixtures are used in conjunction with multiple-spindle cluster boxes and slidable bushing plates mounted on the drill heads. The bushing plates register on four

indexing pins of the fixture at each indexing to insure true alignment.

The parts are loaded and unloaded at the first station of the fixture, which is at the front of the machine. Four holes are drilled at the next station to the left, and two holes are drilled and two countersunk at the third station. No work is done at the fourth station in the rear. Six holes are drilled at the fifth station by the right-hand head, while one hole is drilled and two holes are reamed at the sixth station by the use of the same head.

SOCIETE GENEVOISE PRECISION JIG BORING MACHINE

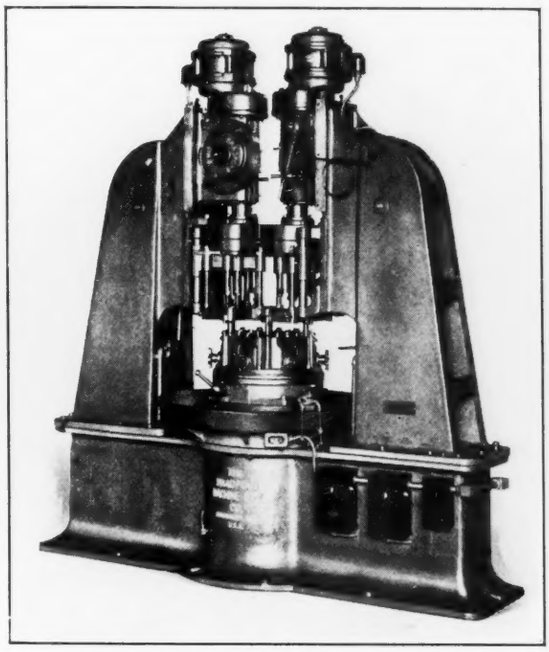
The smallest model that is considered practical for general tool-room use has recently been added to the line of precision jig boring machines made by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland. This machine is being placed on the American market by the R. Y. Ferner Co., Investment Bldg., Washington, D. C., and was exhibited at the Power Show held in New York City during the first week of December.

The new machine is similar to the larger sizes in that the boring head is mounted on a slide that moves horizontally on a cross-rail supported by two upright housings. Vertical motion of the rail is effected through two screws. Accurate measurements are secured by the use of micrometer lead-screws that are employed for moving the boring head and table.

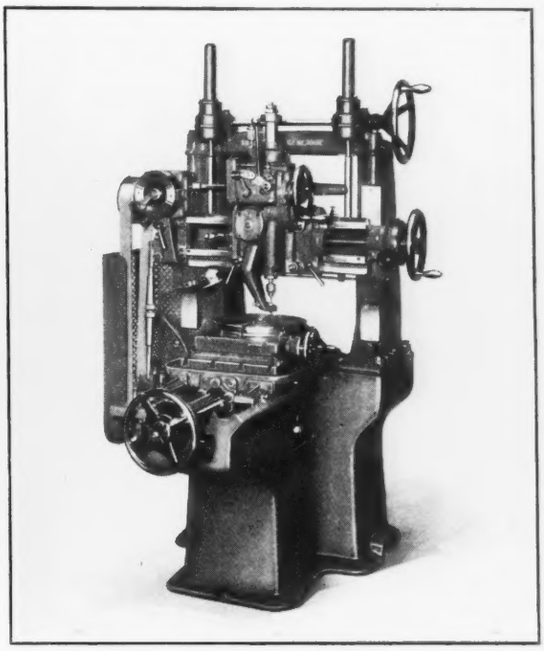
Curved templets attached to the table and cross-slide compensate for small errors that may exist in the lead-screws after lapping. However, use is made of a different lever system than on the other machines for transmitting the corrections to the vernier indexes of the micrometer heads. With the new system, the micrometer index is shifted slightly back and forth to bring it in the correct position to compensate for errors at any point along the corresponding screw. The micrometer head verniers read to 0.00005 inch.

The table of the machine has an area of 327 square inches, the measurements being 15 by 20 1/2 inches. The free distance between the vertical uprights is 23 1/4 inches, and the transverse motion of the boring head, 12 inches. The table can be moved through 18 inches, so that holes can be located, drilled, and bored anywhere within a rectangle measuring 1 by 1 1/2 feet without resetting the work. The vertical travel of the cross-rail is 9 1/2 inches, which, with a minimum distance from the table to the cross-rail of 5 inches, gives a maximum vertical capacity of 14 1/2 inches.

The machine is driven by a one-horsepower, two-speed motor attached to the rear. In combination with a four-speed gear-box



Bradford Two-head Vertical Machine Used for Drilling, Countersinking, and Reaming



Smallest Model of the Line of Societe Genevoise Precision Jig Boring Machines

The drill heads are Bradford standard automatic units, equipped with independent motor drives and cam feeds. Both spindles are operated simultaneously through the movement of the hand-valve at the right front of the machine, which controls air-operated trip units. A push-button controls the entire machine.

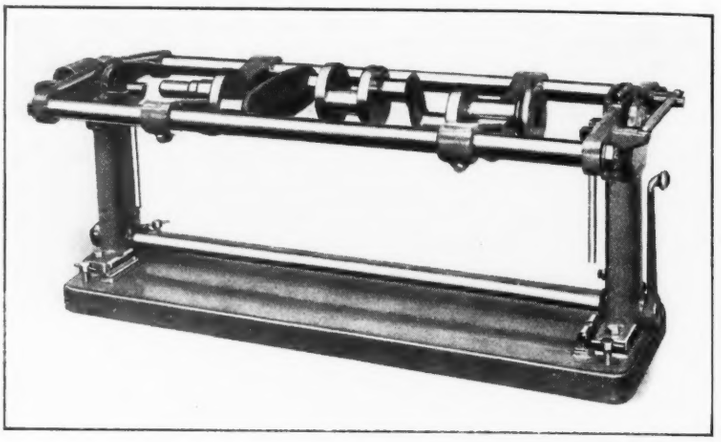
This machine could be readily adapted for general production work by changing the tooling equipment and the multiple-spindle cluster boxes. The indexing table could be arranged with a full automatic control.

of new design, it is possible to obtain eight spindle speeds varying from 135 to 1500 revolutions per minute to suit the drilling and boring of small holes, as well as the drilling of holes up to 1 inch and the boring of holes up to 2 1/4 inches in cast iron. Power feeds of 0.004 and 0.008 inch per revolution are provided.

JENKINS CRANKSHAFT BALANCING MACHINE

Parts that are long and relatively small in diameter, such as automobile crankshafts and rotors for electrical equipment, can be balanced statically in the machine here illustrated, which is a recent development of the Jenkins Machine Co., Sheboygan Falls, Wis. This machine can also be used advantageously as a final check-up on parts that have been placed in running balance.

The operation of determining the heavy side of work is the same as with all Type A machines built by this company. In balancing crankshafts, the shaft can be turned by hand in the opposite direction to that in which the frame tips in order to bring the heavy side up for removing metal by the use of a drilling machine directly beside the balancing equipment.

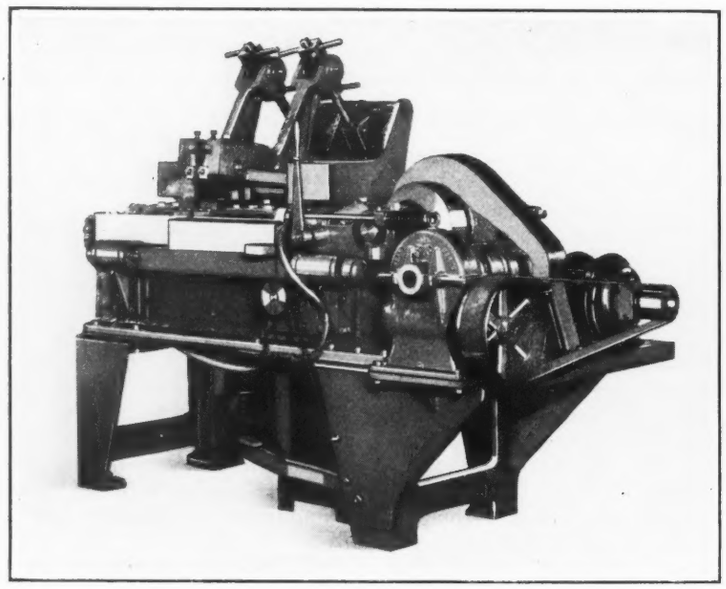


Jenkins Static Balancing Machine with Sliding Weight and Scale Showing Number of Holes to be Drilled and their Depth

For parts handled in considerable quantities, a sliding weight and graduated bar are provided, by means of which the number of holes to be drilled and their depth can be conveniently determined for a given size of drill and a given position on the work. This machine is made in two models, 12 inches in width, and 31 and 68 inches in length, respectively.

THOMSON-GIBB POWER-DRIVEN BUTT WELDER

A power-driven butt welder recently added to the line of electric welding machines built by the Thomson-Gibb Electric Welding Co., Lynn, Mass., and Bay City, Mich., is here illustrated, equipped with universal air-operated open-end clamps. Special clamps and platens can be applied, but equipped as illustrated, the machine has practically universal application, being suitable for butt-welding certain classes of rims or for welding comparatively wide sections of thin strip stock and condensed sections. A water-cooled transformer of 200 kilovolt-amperes is furnished. It is thoroughly protected from flash.



Thomson-Gibb Butt Welder Equipped with Universal-type Air-operated Clamps

The air-operated clamps are actuated through toggle links which are adjustable to take care of a wide variety of work. Stock up to 7 inches in width can be accommodated by the dies and jaws. The jaws are so mounted that they can be quickly removed and replaced when necessary. The dies are water-cooled and are made in various shapes to conform with the work. The valve that operates the clamps is controlled by a foot-treadle. The machine is driven by a two-horsepower motor connected to a gear reduction unit.

In operation, the work is inserted in the dies and then the foot-lever is depressed to close both clamps. A clutch lever is next tripped by hand to start the

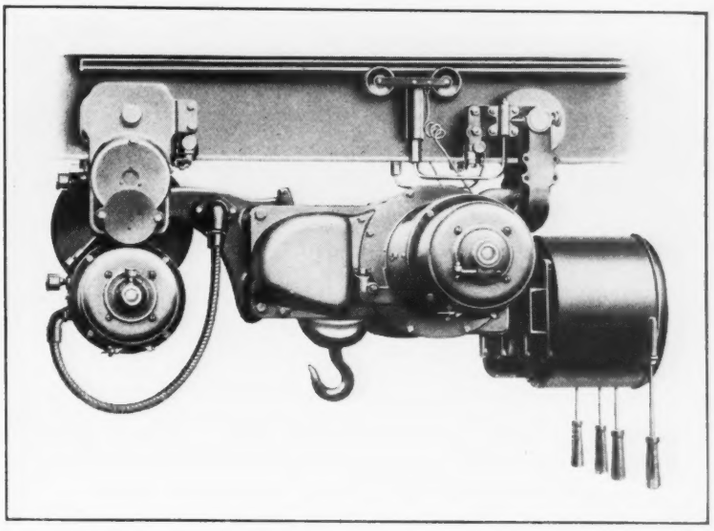
welding cycle, at the end of which the clamps open automatically and the platen returns to the loading position.

SHEPARD-NILES HOIST AND TROLLEY

The illustration shows a "Compact" hoist and Model 21 trolley, which are recent developments of the Shepard Niles Crane & Hoist Corporation, 380 Schuyler Ave., Montour Falls, N. Y. One of the features of this hoist is that by using the same body piece and attaching different standard motor and gear end sections, various speeds or capacities can be obtained. The motor supplied for the various sizes is especially designed for hoisting service.

Cooling fins cast integral with the gear end section insure a cool-operating load brake under the most adverse conditions. All moving parts in the gear end operate in an oil bath. Except on the close clearance type of hoist, the load block is fully enclosed. An improved electric brake and limit switch are supplied. Ball-bearing wheels are provided for the push-type trolley. There is a balanced drive through planetary gearing.

The Model 21 trolley is of all steel construction and is equipped with ball bearings throughout. It is driven by a motor which is mounted directly underneath the trolley sides and rotates about the center line. Only two wheels are used. The trolley is prevented from skewing by the provision of guide rolls. Curves having a radius as small as 3 feet and narrow-throw switches can be negotiated. The load is carried from the top of a yoke instead of being suspended. The illustration shows the "Compact" hoist and the Model 21 trolley assembled.

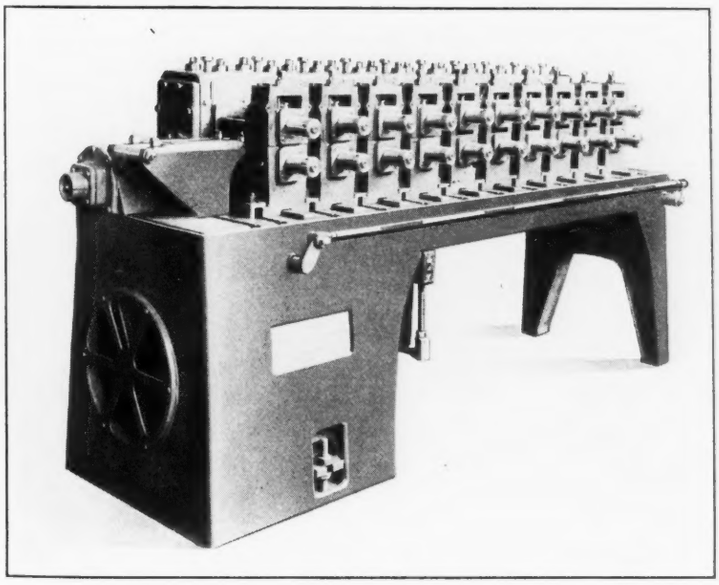


Hoist and Trolley Developed by the Shepard Niles Crane & Hoist Corporation

McKINNEY ROLL FORMING MACHINE

A Model F roll forming machine for producing molding, tubing, and other shapes from strip or sheet brass, copper, zinc, aluminum, steel, or stainless steel has been added to the line of machines built by the McKinney Tool & Mfg. Co., 1688 Arabella Road, Cleveland, Ohio. As may be seen from the illustration, this machine is constructed on the unit plan, there being a series of roll units, each of which carries one pair of work-spindles and has an individual speed reducer. As many of these self-contained units may be incorporated in a machine as desired. The motor that drives all units is located in the base and connected to the drive shaft through multiple V-belts.

The front housings of the various units are adjustable from front to rear along guide strips doweled to the bed. The housings may be clamped at any desired point along these guides. This construction permits the housings to be adjusted to suit wide or narrow sections and provides support to the rolls as close as possible to the working point. A further advantage claimed for



McKinney Roll Forming Machine which can be Equipped with Various Numbers of Roll Units to Suit the Work

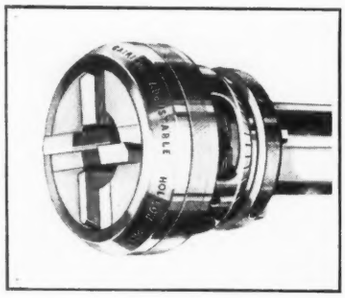
this design is that the set-up time in changing jobs is greatly reduced.

Another important feature of the machine is that it may be used as a standard two-housing machine for heavy work or, by pushing the front housings back until the ends of the work-spindles are exposed, it will serve as an outboard machine for light and medium work. In many cases, it is possible to set up for two jobs at the same time. Rolling speeds of from 100 to 150 feet per minute are practical for most sections, but some jobs can be run as fast as 650 feet per minute.

GAIRING INSERTED-BLADE HOLLOW MILL

An inserted-blade hollow mill of the adjustable construction illustrated has been added to the line of tools manufactured by the Gairing Tool Co., Detroit, Mich. This tool is intended for use in machining bar stock, castings, and forgings, being made rigid for heavy-duty work as well as for light accurate cuts. It really constitutes a combination or two-purpose tool, since both hollow-milling and facing cuts can be taken.

The principal feature of this tool is that adjustment of the blades can be effected by simply rotating the cone-shaped external nut which has a direct bearing on the outer edge of the blades.



Gairing Hollow Mill Equipped with Adjustable Blades

This nut is graduated in thousandths of an inch for setting to any required diameter. The blades are locked securely in the body and are of such a construction that tilting is impossible. Since they are interchangeable, new blades can be inserted when the original sets become worn out with numerous regrindings.

The design and accuracy of this tool are such as to make it suitable for using Stellite or tungsten-carbide blades; however, high-speed steel blades with decarbonized surfaces removed are standard. The blades can be formed or ground to any angle for cutting straight or tapered surfaces.

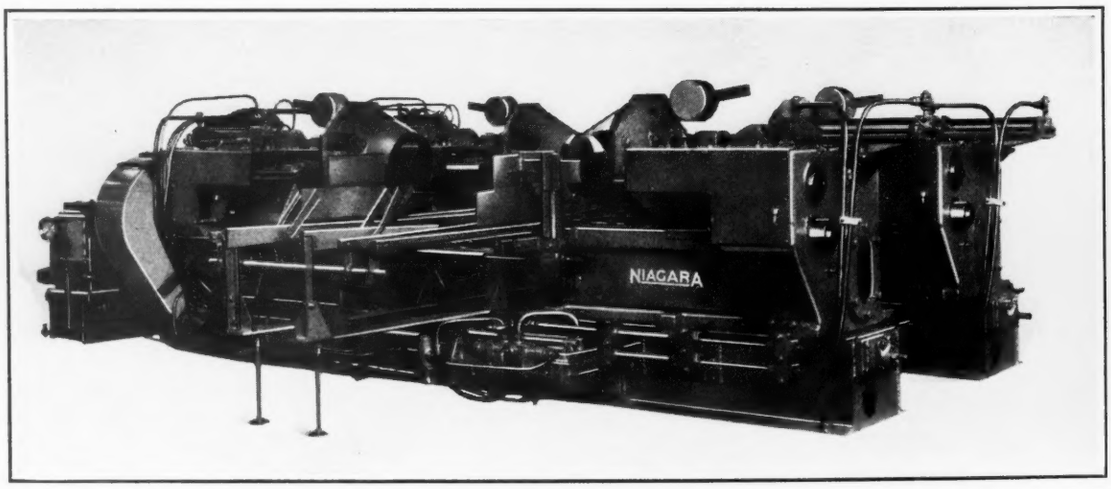
The body can be designed for taking multiple cuts or it can be equipped with drills, reamers, or multiple-operation cutters. Pilots can also be furnished for facing and spot-facing operations. The tool is regularly made in eight sizes for machining to diameters of from 1/8 to 2 inches.

NIAGARA AUTOMATIC DRUM-MAKING MACHINES

The Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., recently finished two units of a set of four high-production automatic drum-manufacturing machines. The finished machines are illustrated, the two final units still being under construction. All four machines have a capacity for steel stock of No. 16 gage, the first machine receiving the drum bodies after they have been rolled into a cylindrical shape and welded.

While progressing through the four machines at a speed of five per minute, each drum body is flanged, a rolling bead is expanded, the rolling bead is rerolled, and the body is corrugated. Only one operator will be required for the four machines, as the drums are automatically fed through the complete set-up and ejected when finished. However, the machines can also be used separately.

Both ends of the drum bodies are worked on at the same time. All machine motions, with the exception of the roll rotation, are controlled by Oilgear hydraulic equipment. Individual motors



Two of a Set of Four Automatic Machines being Built by the Niagara Machine & Tool Works for the Automatic Production of Corrugated Drums

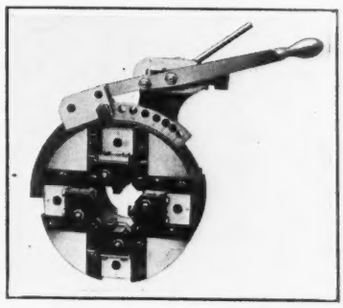
operate the rolls. The feed is of a reciprocating type, each unit being provided with an individual feed.

Two slides which carry the upper rolls are provided with tapered pilot plates. As these slides come toward each other to enter the drum body, the latter is engaged by the pilot plates and is automatically centered. At the same time, the pilot plates round up body shells that have become dented or misshapen. Adjustments provide for handling drum bodies from 9½ to 24 inches in diameter and from 14 to 42 inches in length.

The same concern also builds a double-end heading unit and a horizontal duplex seamer for assembling both heads to the bodies. These two machines could be installed with the four machines described in the foregoing and a production of five drums per minute, with three operators, could be obtained.

"BIKEKO" THREADING DIE-HEAD

One of the features of a threading die-head recently designed by the Bignall & Keeler Machine Works of the N. O. Nelson Mfg. Co., Edwardsville, Ill., is that in threading pipe, an upward movement of a lever will lift all the dies clear of the pipe and any coupling. This die-head, here illustrated, is provided with a positive lock which insures accurate



Die-head with Lever for Lifting Dies Clear of the Work

duplicate threads after an adjustment has been once made for a given size. A fine-pitch adjusting screw permits close settings for either standard or special sizes.

High-speed steel dies with a curved eccentric relief are used. These dies have the cutting edge well ahead of the center line, because the die slides have an exceptionally long travel. One set of dies will accommodate all sizes of work within the capacity of the die-head as long as the taper and thread remain the same. Any one die can be replaced without renewing the entire set.

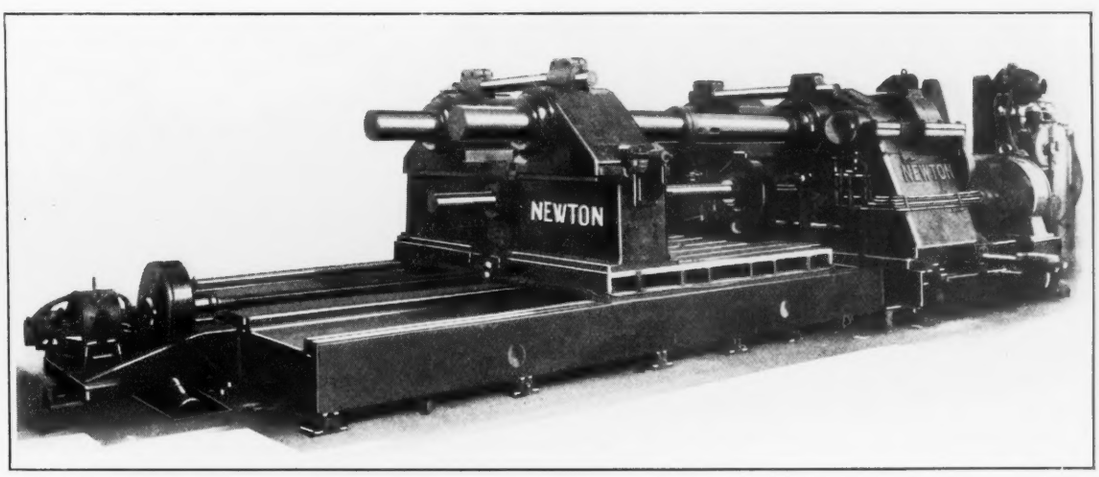
This die-head can be furnished on the new Peerless and PDQC machines, and can be applied to any heavy power-driven threading machine now in service.

NEWTON THREE-SPINDLE HORIZONTAL BORING MACHINE

Motor frames for electric locomotives are bored, counterbored, and faced in the special Newton three-spindle horizontal boring machine here illustrated. This machine was recently built by the Consolidated Machine Tool Corporation of America, Rochester, N. Y., for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and is used in machining fabricated welded steel frames. It consists essentially of a heavy bed plate on which there are three boring heads. Two of these heads carry 10-inch spindles and are adjustable horizontally at right angles to the spindle travel. The third head carries a 6-inch spindle and is adjustable vertically.

The work-table is provided with a power adjustment in line with the spindle travel. Outboard supports for the boring-bars are mounted on the work-table. Horizontal and vertical adjustments corresponding with the adjustments of the boring heads are provided for this outboard unit.

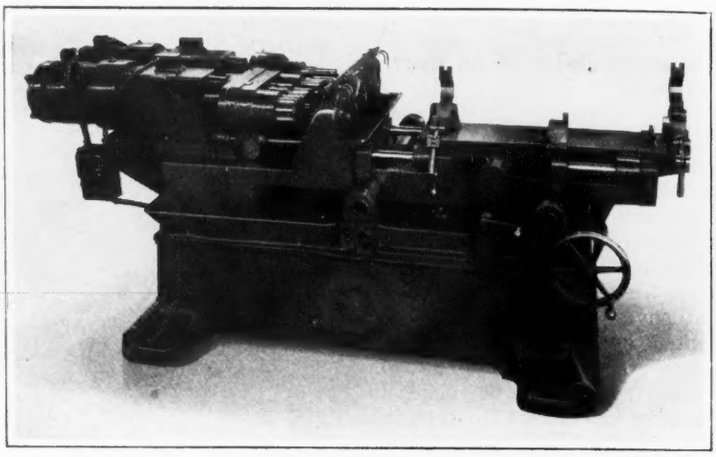
In machining the motor frames, the roughing cuts are taken by multiple tools mounted in heads attached to the boring-bars, and the finishing cuts are taken by single tools. The multiple tools are of a swiveling disappearing type, so constructed that all tools



Newton Three-spindle Machine Built Especially for Boring, Counterboring, and Facing Fabricated Steel Locomotive Frames

can be set to the exact diameter required outside of the job. The tools are then swiveled to withdraw the cutters radially, after which they are passed into the work and are then swiveled in the opposite direction to expand the cutters to the correct diameter for the operation. Micrometer adjustments provide for setting both the roughing and finishing tools to size.

The feed and rapid traverse are controlled through air cylinders. Both hand and power adjustments are provided for each spindle, and graduated dials permit fine settings to be made. The spindles can be set independently, and any spindle can be stopped automatically at a predetermined point in its travel. Each spindle is also driven independently, the two larger spindles through 35-horsepower motors and the smaller spindle through a 10-horsepower motor. Three motors of five-horsepower furnish the feed and rapid traverse for the spindles, and a separate five-horsepower motor is provided for adjusting and traversing the worktable.



Krueger Semi-automatic Machine for Drilling, Reaming, and Tapping Holes in the Flanges of Rear-axle Housings

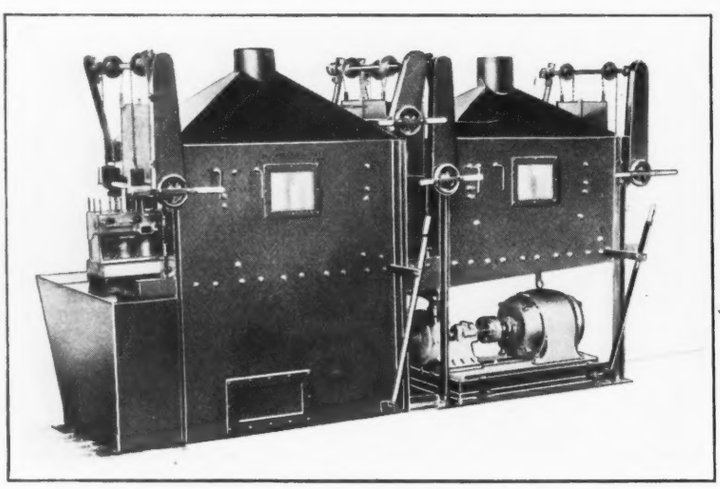
KRUEGER DRILLING, REAMING, AND TAPPING MACHINE

Four groups of spindles are provided on the machine illustrated, for drilling, reaming, and tapping all the holes in the end flanges of an automobile rear-axle housing approximately 66 inches long. This machine was built by the Krueger Division of the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich. It consists of two semi-automatic units, one of which does the drilling and step-reaming, while the other taps all the holes.

A twenty-spindle head mounted on the drilling unit has three groups of spindles, the first consisting of eight spindles which drill 27/64-inch holes, while the second group comprises four spindles for drilling 29/64-inch holes. The third group of spindles step-reams eight holes 1/2 inch in diameter for a depth of 1/8 inch, and 7/16 inch in diameter for the remainder of the hole length. The head on the tapping unit taps eight 1/2-inch holes.

The work-holding fixture consists of a compound table which is indexed by moving it to the right and at the same time into the loading position. The part is located in two vees and clamped by an adjustable cam. A device provides for tilting the part to the proper angle for drilling either end. This fixture is held in the drilling position by a lock connected directly to the handle at the front of the machine.

The drilling unit is started by pressing the button at the front of the machine, the machine then completing its drilling cycle before stopping. Next, the cross-slide is indexed to the second drilling position by releasing a plunger in the center of the cross-slide and turning the handwheel at the extreme right-hand end of the machine. Indexing for the remaining two operations is accomplished in the same manner. There are separate controls for the drilling and tapping units.



Ransohoff Cleaning Machine Designed for Handling Cylinder Blocks

RANSOHOFF CYLINDER CLEANING MACHINE

The cleaning machine here illustrated was recently built by N. Ransohoff, Inc., Cincinnati, Ohio, and is being used in an automobile plant for cleaning cylinder blocks thoroughly just

before they reach the assembly line. Each cylinder block reaches the cleaning machine on a wooden block, riding on a roller conveyor, and enters a vapor-tight chamber where it encounters an automatic stop. Then cleaning fluid is sprayed on and into the casting from a large number of nozzles, so arranged as to register with all the valve holes and cylinder bores. The solvent loosens grease, oil, dirt, chips, and other foreign matter.

Next, the operator releases the block to allow it to travel into a second compartment, where another series of nozzles applies air under high pressure to remove the loosened dirt and any excess fluid that may remain in pockets of the casting. The nozzles of this equipment are so mounted that the simple pull of a lever re-positions them to suit a different size of cylinder block. Thus two sizes of blocks can be conveniently handled by the machine.

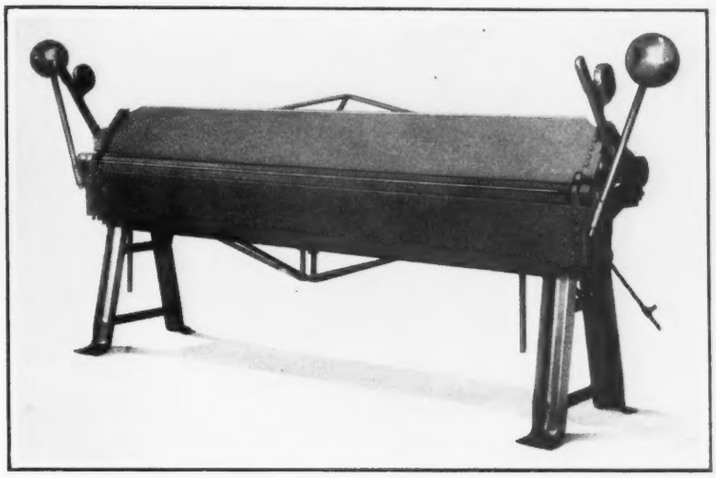


Fig. 2. Dreis & Krump Hand-operated Steel Bending Brake

SHEAR AND HAND BRAKE OF ARC-WELDED CONSTRUCTION

The power squaring shear shown in Fig. 1 has been added to the line of Chicago all-steel machines built by the Dreis & Krump Mfg. Co., 74th St. and Loomis Blvd., Chicago, Ill. This shear is built of steel plates arc-welded into a solid unit. The bed and top leaf have welded cross-bracing and the housing has a welded reinforcement around the gap. The gears are also made of rolled-steel sections, welded together. This machine can be furnished in lengths of from 36 to 168 inches and in capacities of from No. 14 gage to 1 inch. Lubricant is provided to all moving parts through a centralized system. The hold-down is made so that full pressure is applied before the knives start to cut.

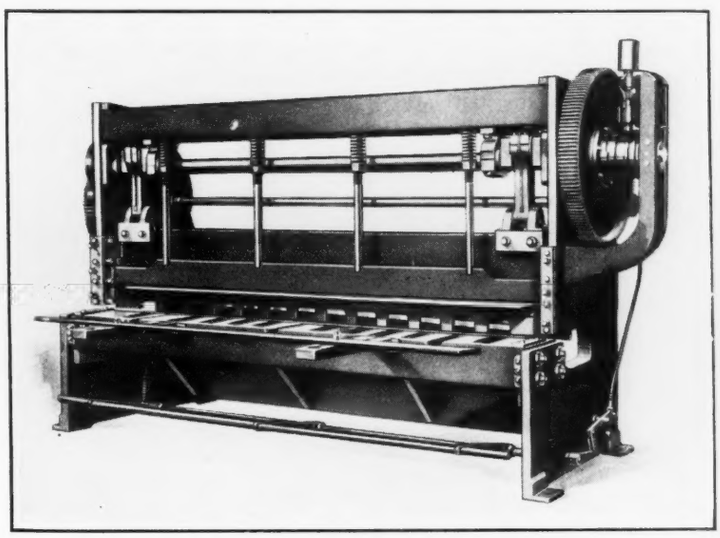


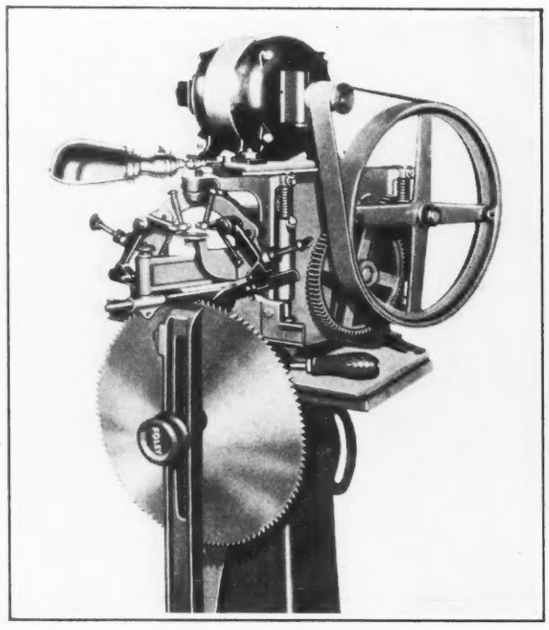
Fig. 1. Power Squaring Shear Built up by Welding Steel Plates Together

The same concern has also produced an improved hand-operated steel bending brake of the design shown in Fig. 2. Except for changes in the construction, this model is of a type made by the concern for over thirty years.

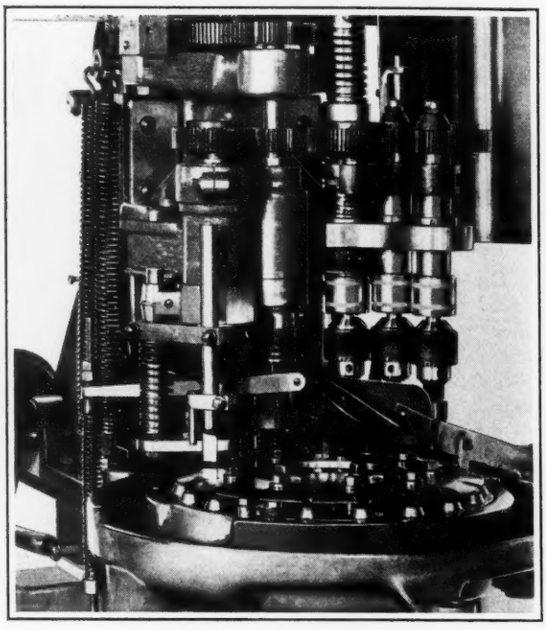
The changes include the substitution of electric arc welding of all rolled-steel sections for riveting. Also, the legs are now made of pressed-steel sections instead of angle bars. This change has added to the strength of the equipment and also improved its appearance. Cross-bars provided in the legs can be used for shelves to hold the formers, which are standard equipment. A new type of adjusting link provides four times the adjustment of the old eccentric link. This is an important feature when bars must be clamped with the material that is to be bent.

FOLEY AUTOMATIC SAW FILER

Circular, band, and hand saws are sharpened automatically in an improved machine exhibited at the New York Power Show by the Foley Mfg. Co., 11-15 Main St., N. E., Minneapolis, Minn. The illustration shows this machine set up for handling circular saws, which it accommodates in sizes of from 3 to 24 inches in diameter and with from 3 to 16 points to the inch. Circular



Foley Automatic Saw Filing Machine Sharpening a Circular Saw



Anderson Dial-feed Machine Arranged for Drilling as well as Tapping

saws for brass and copper, as well as for wood, can be filed.

Band saws from 1/8 to 4 1/2 inches wide and with from 3 to 16 points to the inch are handled by attaching adjustable rods and wheel mountings over which the band saws can be slipped. Saws of this type up to 24 feet long can be accommodated regularly. Carriers are applied to the front of the machine for filing hand saws. The machine is made in both bench and pedestal types.

ANDERSON DRILLING AND TAPPING MACHINE

While the No. 40 dial-feed tapping machine built by the Anderson Die Machine Co., Bridgeport, Conn., was primarily designed for tapping, it has recently been arranged for drilling holes of limited depth and tapping them in one pass of the work.

In the machine provided with the equipment shown, the drilling is done by three spindles on the right-hand side. The movement of the third spindle from the right is controlled by an adjustable depth stop which acts independently of the other two drilling spindles in order to insure the proper depth of hole under normal conditions. However, abnormal conditions may affect the drilling, as, for instance, a hard material or dull drills. Therefore, in order that any variations in the drilling shall not affect the tapping, a mechanism has been provided that gages the depth of the drilled holes previous to the tapping operation and stops the machine if the holes are not of the proper depth. This mechanism could also be applied to countersinking or counterboring operations.

The depth of the tapping is controlled primarily, as on the standard machine, through the use of the crank motion and the segment principle of reversing the tap. However, there is also a positive lead control directly on the tapping spindle. This mechanism is so designed that the feed of the tap is rapid to within about 1/32 inch of the work, and then is made to correspond with the lead of the tap. Similarly, on the reverse, the tap is withdrawn at a rate corresponding with its lead until free of the work, at which time it is withdrawn rapidly. The tap lead control does not affect the feed of the drilling spindles. Small parts drilled and tapped in this machine are ejected automatically at rates of from 1200 to 1500 pieces per hour.

DAVIS & THOMPSON SIX-SPINDLE INDEXING MACHINE

Six different operations are performed on the distributor hole of automobile engine cylinder blocks by means of the machine here illustrated, which was built by the Davis & Thompson Co., 57th Ave. and Mitchell St., Milwaukee, Wis. The operations consist of drilling two holes of different sizes; spot-facing to two different dimensions and fly-cutting; and reaming the holes to different sizes.

The various tools are brought into position over the distributor hole by means of the vertical indexing head. This head is indexed automatically by the use of Oilgear hydraulic equipment. The six spindles of the head are mounted in Timken tapered roller bearings. The spindle speeds can be changed to suit any operation, and their feed is governed by the Oilgear equipment. There is a rapid traverse of the tools to the

work and a separate feed to suit the cutters. The reaming bars are piloted in a rotating ball-bearing guide which is located in the table.

The cylinder block is locked in place for the operation by means of air clamps, there being an air cylinder below the table as well as on top. After the operator places a cylinder block on the table and moves the lever at the left of the machine, the complete cycle of operations is performed automatically before the machine stops.

The Davis & Thompson Co. has also built recently an eight-spindle continuous vertical drilling machine of the same general construction as the twelve-spindle equipment described in November, 1929, MACHINERY, page 235. However, on the new machine, the pan provided at the base for holding coolant does not revolve. Also, a conveyor is mounted on this pan to carry away all chips as they are removed from the bottom of the pan by a wiper on the guard that surrounds the column. Surrounding the spindles is a coolant tank or reservoir into which the coolant is pumped, so that it can flow by gravity to the parts being drilled.

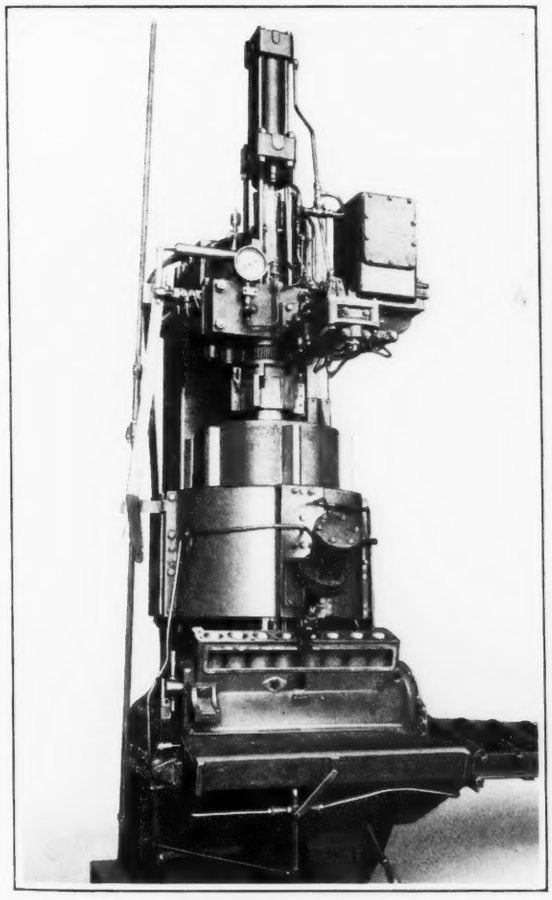
Equipped with a flexible cam similar to the twelve-spindle machine, the new machine can be adjusted conveniently for drilling holes to any depth. Holes up to 2 inches in diameter can be drilled in steel. The table is made in halves, and is raised and lowered on the column by means of a screw. Lubricant flows continuously from a reservoir at the top of the machine to all the bearings.

The twelve-spindle machine previously described has been redesigned to include the new coolant tank and conveyor provided on the eight-spindle machine.

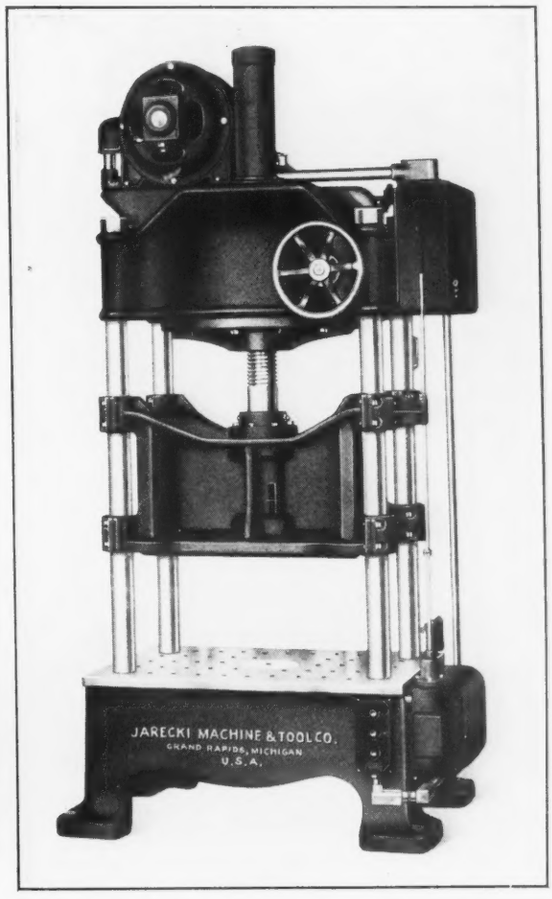
JARECKI POWER SCREW PRESS

The 100-ton power screw press here illustrated has recently been added to the line of equipment manufactured by the Jarecki Machine & Tool Co., Hall St. and Steele Ave., S. W., Grand Rapids, Mich. This press is operated by a 10-horsepower motor, and is equipped with an automatic reversing type of switch that enables the operator to predetermine the depth of ram travel before the automatic reverse is engaged to return the ram to its normal position. Two limit switches regulate the extreme travel of the ram in both directions.

A push-button type of switch, conveniently located, enables the operator to start, reverse, or stop the ram instantly without taking his eyes off the work. Consequently, a diemaker requires no help in handling any dies, and



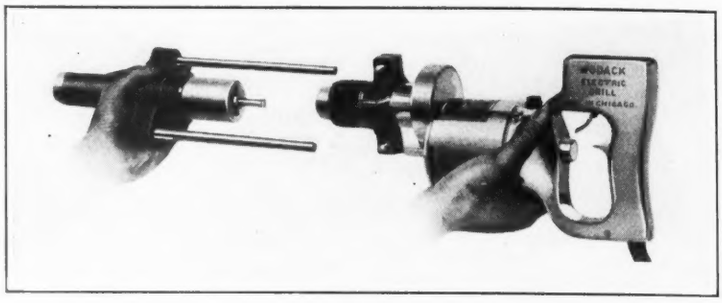
Davis & Thompson Indexing Machine which Employs Six Tools in One Cycle



Jarecki Power-operated Screw Press with Automatic Reversing Switch

the equipment constitutes a one-man machine. The handwheel on the head may be used to move the ram a fractional part of an inch.

Ample clearance is provided between the bed and ram. Dies can be blocked up on parallels to allow clearance for springs, cams, etc., or to permit the punch action in a die to be inspected, if this should be required.



Wodack Dual Electrical Tool Comprising a Drill and Hammer

KIPP AIR FILER

An air filer has now been added to the line of Kipp pneumatic tools manufactured by the Madison-Kipp Corporation, 203 Waubesa St., Madison, Wis. This tool operates at speeds of from 500 to 5000 strokes per minute, depending upon the amount of air admitted by the trigger valve. Kipp files are held in this tool by means of a hand-operated collet. Many different shapes of files are available, and they can be quickly inserted or removed to suit the work. The operation of the tool is similar to that of the air chipper described in December MACHINERY, page 313, the mechanism employed being of the Kipp turbine-rotary valve-piston design.

The pistol grip permits a natural position of the filer in the user's hand, and it can be held in any position to give easy access to the work. The air-cushioned piston eliminates vibration and thus provides smooth cutting strokes for the file.

One of the features is a file guide, which is keyed to the spindle just in back of the collet and is held in the body by a screw thread. This guide is octagonal in shape and can be held by the thumb and index finger of the operator's left hand and turned to guide the file over the irregular surface. Turning the guide fully to the right, locks it to the body. The position of the file can then be changed by the pistol grip handle.

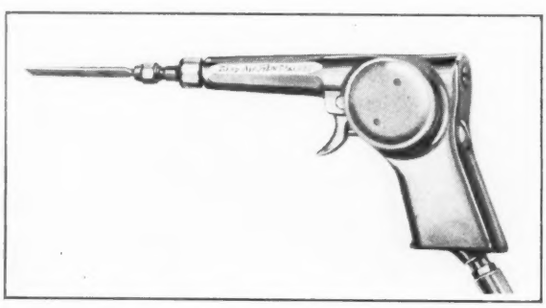
Like the air grinder and air chipper made by the Madison-Kipp Corporation, this air filer was developed in the tool-room of the concern, which specializes in the production of intricate die-casting and punch-press dies, as well as handling the ordinary run of tool-room work. The filer has been found suitable not only for filing work, but also for honing and other operations where rapid strokes approximately 1/4 inch long are to be made. There are but few moving parts and these are lubricated by the air stream from a well in the pistol grip. The weight of the filer is only 1 1/2 pounds, and its length is 7 inches.

WODACK COMBINATION DRILL AND HAMMER

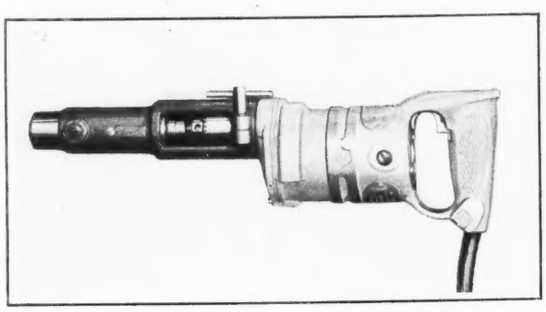
A dual type of tool that can be used both as a drill and a hammer has been added to the line of portable electric tools manufactured by the Wodack Electric Tool Corporation, 4627-4629 W. Huron St., Chicago, Ill. This tool is particularly suited for such work as drilling holes up to 7/8 inch in stone, concrete, or brick to receive expansion bolts. It is said that only about one minute is required to drill a 9/16-inch hole 3 inches deep in concrete. Holes from 0 to 3/8 inch can be drilled in metal and holes up to 1/2 inch can be drilled in wood. Grinding, scratching, and buffing wheels and a bench stand can be furnished for use with this tool. The tool itself weighs 12 pounds.

MILWAUKEE HAMMER-DRILL

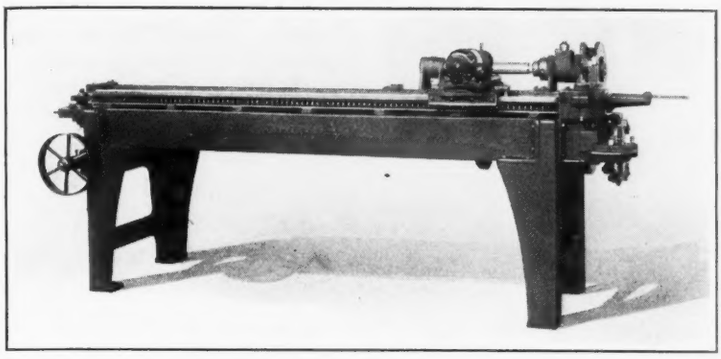
Holes up to 1 inch in diameter can be hammered in concrete or brick, and holes up to 5/16 inch in diameter can be drilled in steel or wood with a combination tool which has recently been developed by the Milwaukee Electric Tool Corporation, Milwaukee, Wis. The hammer attachment is constructed with only two moving parts, and is made to fit a ball-bearing electric drill which operates at an



Kipp Air Filer which Makes from 500 to 5000 Strokes per Minute



Milwaukee Hammer-Drill for Producing Holes in Concrete, Metal, or Wood



Langelier Drilling Machine which Produces Holes in Rows Running along Rolls

unusually high speed. The attachment delivers 3600 blows per minute, and will drill a 1/2-inch hole 2 1/2 inches deep in hard concrete in one minute. The tool weighs 9 1/2 pounds, and is provided with a universal motor for operation on either alternating or direct current.

LANGELIER AUTOMATIC ROLL-DRILLING MACHINE

A machine designed primarily for drilling a series of holes in wooden rolls from 2 to 8 inches in diameter and up to 6 feet in length was recently built by the Langelier Mfg. Co., Providence, R. I. Although this machine is especially intended for operation on wooden rolls, it could, of course, also be applied to drilling metal.

The hole center distances along the roll length can be varied from 1/4 to 7/8 inch in increments of 1/8 inch. Any even number of rows from 8 to 96 can be drilled around the rolls. The holes in adjacent rows are staggered alternately, and any linear spacing of holes along the length of the roll can be obtained in conjunction with any number of rows around the roll.

The headstock is bolted in a fixed position at one end of the machine, while the tailstock is adjustable to accommodate any length of roll. The headstock is indexed automatically by a pawl and ratchet wheel mechanism. The drilling head is mounted on a cross-slide located on top of a saddle which is indexed along the bed.

Indexing of the drilling unit from one end of the roll to the other is accomplished by means of a long roller chain that runs on sprocket wheels mounted at the ends of the machine. The right-hand sprocket shaft is indexed by means of bevel gears and a ratchet wheel actuated by two pawls, first in one direction and then in the opposite direction. The indexing movement of the drilling-unit saddle is automatically reversed when the extreme hole at either end of the roll has been drilled, the roll being indexed at the same time. This machine weighs approximately 3000 pounds.

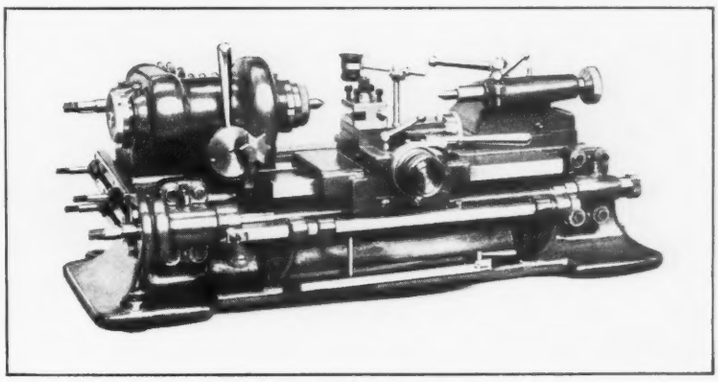
SWISS PRECISION THREADING LATHE

The smallest of five precision screw-cutting lathes which have been manufactured for years by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, has recently been redesigned and is now being introduced in the United States and Canada by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. This redesigned lathe is equipped with a bored spindle that permits the use of spring collets and the machining of long thin pieces, as well as the handling of large pieces on a revolving center. The machine is also provided with a slotted faceplate for internal threading. Other improvements include adequate provision for the lubrication of all bearings.

Change-gears are furnished regularly for cutting 36 pitches of threads between 4.5 and 100 per inch, as well as 37 metric pitches from 0.1 to 5 millimeters. The lathe will cut external threads up to 2 inches in diameter, and has a maximum distance of 8 5/8 inches between centers.

Automatic compensation for any small errors that may exist in the lead-screw is effected by means of an arm that extends from the lead-screw nut to a curved slot in a plate at the front of the machine. The curvature of this slot is determined from accurate measurements of the screw errors. The curved slot and arm serve to impart a slight additional rotation to the nut or to retard the nut so as to place the cutting tool at all times in the correct position. The plate that carries this slot can be rotated about an axis to make corrections for room temperatures between 32 and 68 degrees F.

The headstock is fitted with reversing gears, a clutch coupling, and a connecting-rod with adjustable stop pieces. With this



Societe Genevoise Precision Threading Lathe of Improved Design

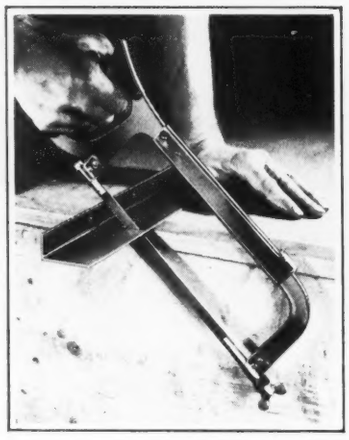
mechanism, the clutch coupling stops the lathe automatically at the end of the carriage travel in either direction, in order to avoid any danger that might otherwise occur from inattention on the part of the operator.

ELWELL-PARKER ELECTRIC TRUCKS

The electric truck here illustrated was recently brought out by the Elwell-Parker Electric Co., Cleveland, Ohio, for handling skids originally designed for use with hand lift trucks. As such skids are usually low, the new truck is provided with heavy steel forks which extend in front of the truck proper and are pushed under the skids. The forks can be lifted on the uprights for tiering skids three high.

This truck is also provided with a swivel boom that can be used for loading skids, swinging a heavy piece into a machine, or carrying work from place to place. The boom has a capacity of 2000 pounds. It is swung out of the way when skids are being handled, and when the boom is in use, the two forks are swung upward. Another feature of this equipment is that the uprights may be tilted forward 8 degrees or backward 35 degrees.

The same company has also brought out a small tiering truck intended for use in the smaller plants. This truck has a capacity of 3000 pounds. Its 18- by 7-inch platform will raise skids from 24 to 30 inches wide by 48 inches long to a height of 63 inches.



Using the Starrett Semi-Flex Hacksaw Blade for Cutting an Angle-iron

STARRETT SEMI-FLEX HACKSAW BLADE

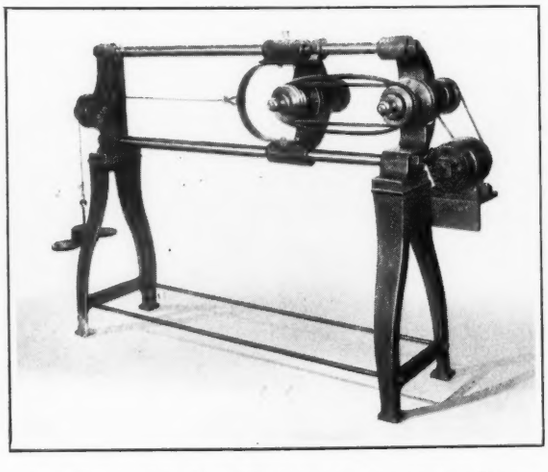
A new hacksaw blade known as the Semi-Flex is being introduced on the market by the L. S. Starrett Co., Athol, Mass., to take care of troublesome jobs that cannot be handled readily with ordinary blades. It cuts pipe, tubing, wire cable, electrical conduit, and other soft or thin metals with ease. As the name implies, the blade is flexible and can be used on jobs that strain or twist the blade without fear of breaking. It is made of tungsten steel, and is tempered to prevent "shelling" of the teeth. In the illustration, a Semi-Flex blade is being used for cutting a piece of angle-iron — an operation that would cause ordinary blades to chatter and bind.

NORMAN BELT-ENDURANCE TESTING MACHINE

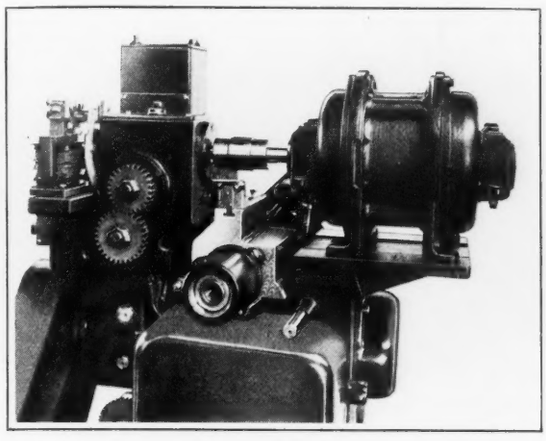
A means of determining the life of belts without the necessity of transmitting a large amount of power is provided by the Norman belt-endurance testing machine illustrated, which has been placed on the market by the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa. This machine is based on the patented principle of running two parallel belts over pulleys of slightly different diameters. No power is taken from the driven shaft, but one of the pulleys tends to drive this shaft a little faster than the other. Consequently, one belt acts as a brake on the other, one of the belts pulling with the top strand and the other pulling with the bottom strand.

Tension is produced in the belts by dead weights suspended on a wire attached to the sliding cross-head in which the driven shaft is assembled. By varying the slip, the pulley diameters, the pulley speeds, and the load, the life of belts can be reduced from months and years to less than an hour. The machine can also be built for testing four belts.

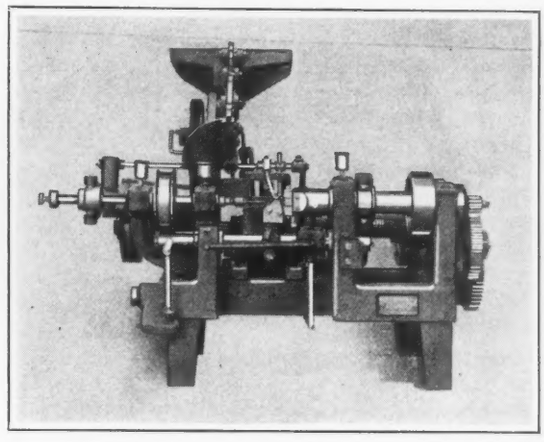
Elwell-Parker Electric Truck with Hinged Forks and a Swivel Boom



Belt Testing Machine Marketed by the Tinius Olsen Testing Machine Co.



Reversing Drive for the Threading Spindle of Goss & De Leeuw Chucking Machines



Townsend Automatic Machine for Secondary Operations on Screw Machine Products

GOSS & DE LEEUW THREADING-SPINDLE REVERSING DRIVE

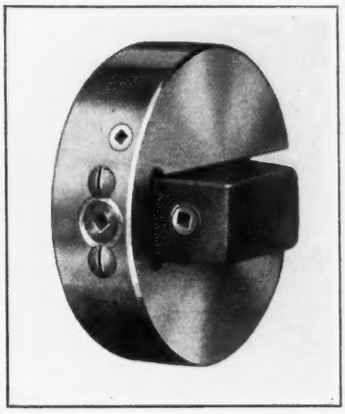
The threading spindle of the multiple-spindle chucking machine built by the Goss & De-Leeuw Machine Co., New Britain, Conn., which was described in August MACHINERY, page 994, is now provided with an independent electric reversing drive. This drive includes a reversing motor, which transmits power through worm-gearing and pick-off gears direct to the spindle. Starting, reversing, and stopping of the spindle can be effected by merely throwing an electric switch, no clutches of any kind being used. The shock of reversal is eliminated by the cushioning effect of the motor. The instant and positive reverse obtained insures that the tap or die will always reverse at the same point, thus permitting threading to be done close to a shoulder or to the bottom of a blind hole.

The operation of this drive is entirely automatic, as the forward motion of the main slide throws the switch into the forward position and the mechanism itself operates the switch for reversing and stopping. The starting, reversing, and stopping points are all adjustable.

The pick-off gears provide a wide range of speeds, while the spindle feed is controlled by means of a positive lead-screw that is always in engagement with the lead-nut. Two threads of different pitches can be cut simultaneously in the same spindle, and both right- and left-hand threads can be produced.

TOWNSEND AUTOMATIC MACHINES

The illustration shows one of a series of automatic machines built by the H. P. Townsend Mfg. Co., Hartford, Conn., for handling previously formed blanks and small tubes or shells, as well as for performing secondary operations on screw machine products. The machine shown can be used for pointing, forming, shaving, drilling, and hollow-milling. The drilling mechanism can be used in conjunction with a forming tool or independently for drilling hollow rivets. Drills up to 1/4 inch in diameter can be used. A hopper is provided for feeding headless blanks and small tubes or shells automatically.



Flynn Boring Head which may be Offset 3 Inches

Three sizes of these automatic machines are built to handle work up to 5/8 inch in diameter by 5 inches in length. The No. 1 machines will give a production as high as 100 pieces per minute, and the No. 2 machines, a production up to 80 pieces per minute. Machines may be installed singly or in batteries to be driven by overhead belts or by individual motors.

Another machine of the same general type, but arranged with two opposed drill spindles, has been constructed recently for cross-drilling cotter-pin holes in parts up to 7/16 inch in diameter by 3 1/2 inches long. This machine is equipped with a magazine feed requiring frequent attention from the operator, which is a desirable factor because the drills must be kept sharp and a close watch on them is necessary. It is also built in three sizes.

FLYNN MICROMETER BORING HEAD

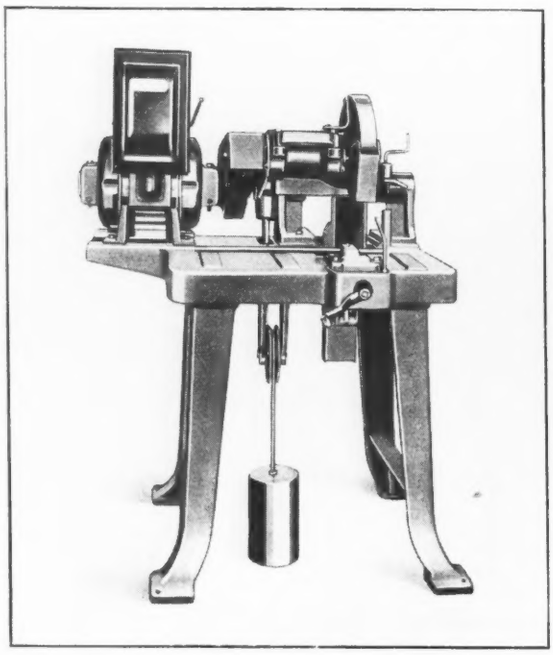
Three inches of offset are available on the No. 18 Flynn micrometer offset boring head which has recently been added to the line of tools made by J. M. Waterston, 423 Woodward Ave., Detroit, Mich. This boring head is intended for use on metal pat-

terns or other work requiring a large offset in the tool-holder, the 3-inch offset giving a 6-inch diameter. The dial is graduated to 0.001 inch to permit accurate adjustments. The bar capacity of this head is 15/16 inch; the diameter is 6 inches; and the weight, 12 pounds.

CAMPBELL ABRASIVE CUT-OFF MACHINE

Steel, iron, non-ferrous metals, fiber, and other materials can be cut off quickly by means of an abrasive disk in a machine exhibited at the New York Power Show by Andrew C. Campbell, Inc., Waterbury, Conn. It is claimed that the cutting time on this machine is a matter of seconds, that the cuts are smooth and true, that the material is not damaged by heat, and that there is no danger of drawing the temper of parts.

The handle used in feeding the abrasive disk is so arranged that the operator can use either hand in cutting material. The belts and the abrasive disk are guarded so as to prevent injury of the operator. Finished pads are provided on the table for attaching fixtures to suit production jobs. The motor is mounted on the bed of the machine and transmits power to the shaft on which the abrasive disk is mounted through a V-belt drive.



Campbell Cutting-off Machine which Makes Use of an Abrasive Disk

KRUEGER HORIZONTAL MULTIPLE-SPINDLE TAPPING MACHINE

Thirteen holes of different sizes and various depths are tapped simultaneously around the periphery of a drop-forged steel part in the Krueger horizontal type of machine here illustrated, which was recently built by the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich. The production is approximately 240 pieces per hour. From the positions of the spindles as seen in the illustration, it will be obvious that the holes tapped are spaced unevenly around the part. One of the parts is shown at the right of the machine.

The work is locked in the fixture at the center of the machine by a single-point overhead clamp, which is forced securely on the work when the crank-handle is turned through an arc of 180 degrees. The taps range from 3/16 to 9/16 inch in diameter, and are fed to the work by individual lead-screws ground on the ends of the spindles. Each lead-screw is driven by a master gear through a stationary nut. The machine proper is driven by a 7 1/2-horsepower reversing-type motor controlled by an adjustable time-limit switch which governs the maximum travel of the taps.

Coolant is fed to each tap by an individual pipe connected to a manifold. Heavy streams of coolant can be provided so as to wash away all chips from the taps and from the locating points on the fixture.

Krueger Machine which Taps Thirteen Holes of Different Diameters and Depths

HOB LEAD AND CONTOUR TESTING EQUIPMENT

A machine of the sine-bar type, designed for checking hob leads from 0 to 2.6 inches, has recently been designed by the Michigan Tool Co., 7171 Six Mile Road, E., Detroit, Mich. This machine is

shown in Fig. 1. It is said that the use of the sine bar eliminates the possibility of lead-screw errors showing up in hobs, errors of this kind sometimes covering up errors in the hob lead or deviations of the hob teeth from the true helical path, and at other times tending to exaggerate them.

Readings of 0.0001 inch are obtainable by means of the indicator. In the inspection of a hob, contact is made against the cutting edge of a hob tooth and the indicator dial is set to zero. Then, as the table of the machine is advanced, the hob rotates and the slide that carries the indicator moves transversely away from the table. The amount of slide movement in one convolution of the hob is controlled by the setting of the sine bar, and is equal to the lead of the hob being checked. This setting is determined by the helix angle of the hob and is positive.

Rotation of the hob is accomplished by a master rack and gears. If the hob has been made correctly, the indicator will register zero on all cutting edges. However, if there is a deviation of the hob teeth from the true helical path due to form-grinding, if the hole in the hob is large and does not fit the arbor, or if the hob gashes are not properly spaced, the indicator will register great variation as the cutting edges of the hob pass the indicating points.

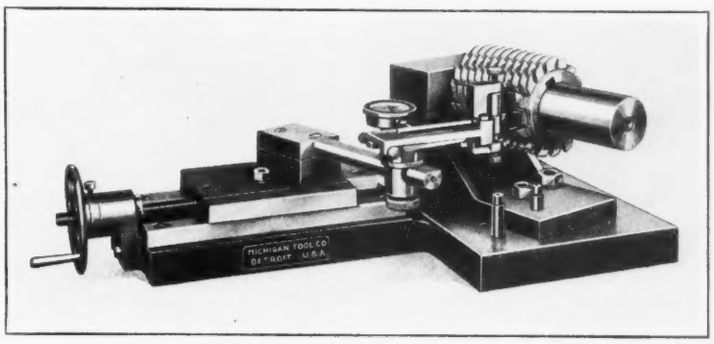


Fig. 2. Fixture for Testing the Contour of Hobs of Any Pressure Angle

Fig. 2 shows a fixture produced by the same company for checking the contour of hob teeth. It is provided with a knife-edge that registers such depressions and elevations as are caused by rough-grinding. The fixture also shows any deviation from the true pressure angle.

Like the lead-testing machine just described, this checking fixture may be set by means of a sine bar for checking any pressure angle. This eliminates the necessity of having a number of interchangeable angle-blocks for different pressure angles. The indicator arrangement is such that the contours of hob teeth can be checked in ten-thousandths of an inch.

PEASE JUNIOR SHEET DRYER

Blueprints, negatives, and blue-line or brown-line prints up to 24 inches in width can be dried in the Junior dryer here illustrated, which is manufactured by the C. F. Pease Co., 822 N. Franklin St., Chicago, Ill. When a chromium-plated cylinder is used, the equipment is particularly adapted for drying photographic prints.

This moderate-sized dryer closely resembles the larger sizes made by this concern. Prints are fed into the dryer over a brass scraper rod and up an inclined feed table which drains the water from the drying drum and prevents steam pockets and creased prints. All surplus water

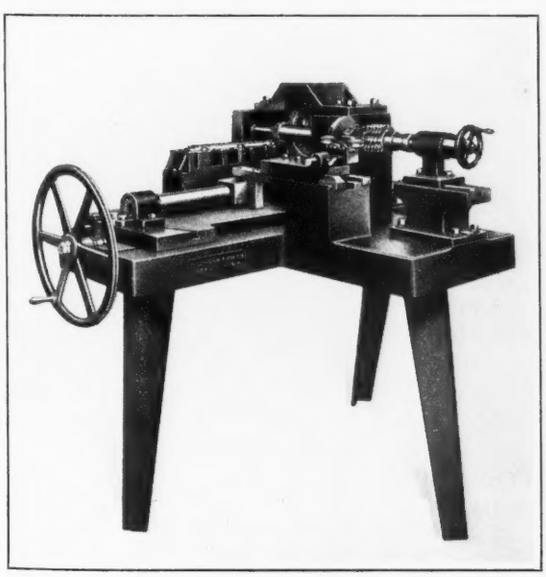


Fig. 1. Machine Made by the Michigan Tool Co. for Checking the Lead of Hobs

Pease Drying Machine for Prints and Negatives up to 24 Inches in Width

is collected in an adjustable drip pan directly beneath the feed table. This pan can be raised or lowered as required for handling either long or short prints.

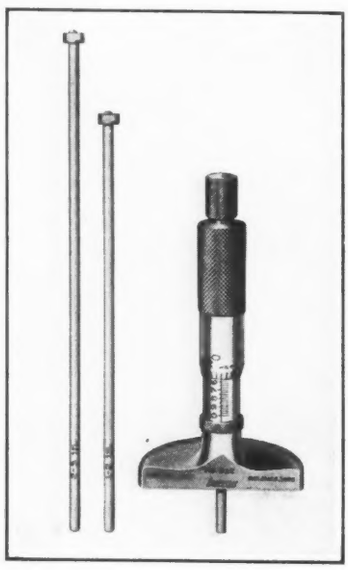
After drying, the prints are automatically returned to an adjustable tray at the front of the machine, and when unusually long prints are being run, the tray can be pushed back out of the way. The drying drum can be furnished with either gas or electric heating elements. When equipped with a gas heater, the proper drying temperature is obtained in about three minutes, and when an electric heater is provided, the proper drying temperature is reached in about ten minutes.

This equipment is driven by a 1/8-horsepower motor. Two speeds of either two or three feet per minute are available through a variable gear drive.

LUFKIN DEPTH GAGE WITH HALF-ROUND BASE

Because of its half-round base, a micrometer depth gage which is being introduced to the trade by the Lufkin Rule Co., Saginaw, Mich., can be conveniently used right along the edge of work. The measuring capacity of this tool is from 0 to 3 inches, varying by thousandths of an inch. This range is available through the use of three interchangeable rods which are secured by means of the knurled cap. The screw has a movement of 1 inch.

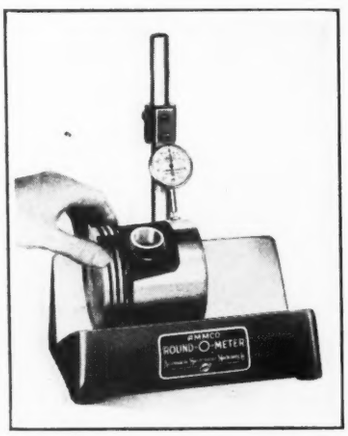
Each gage is equipped with a patented lock-nut to maintain readings, and can be furnished with or without the ratchet stop. The half-round base is 2 inches in diameter, and the rods are 3/32 inch in diameter, thus adapting the gage for use in close places.



Lufkin Depth Gage which may be Used Close to Edge of Work

AMMCO ROUND-O-METER

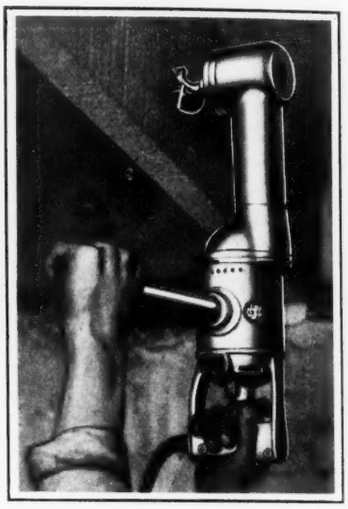
A direct-reading indicator by means of which the roundness and size of any round part from 3/4 to 6 inches in diameter can be checked to 0.0005 inch has been brought out by the Automotive Maintenance Machinery Co., 816 W. Washington Blvd., Chicago, Ill. This device is particularly suitable for the inspection of such parts as automotive pistons, bushings, sleeves, bearings, and pins. By using Ammco gage setting rings, the device can also be used for direct measurement and comparative checking. These rings can be furnished for any dimension within the range of the equipment.



Round-O-Meter for Checking Roundness and Diameter

RIGHT-ANGLE PORTABLE ELECTRIC DRILL

A portable electric drill of a right-angle design that facilitates drilling between joists and other close places has been added to the line of electrically driven equipment made by the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio. This new appliance accommodates bits up to 2 1/2 inches in diameter. It runs at 210 revolutions per minute, and is driven by a universal motor that operates on either alternating or direct current. The drill is equipped with a short-circuit-proof trigger switch.

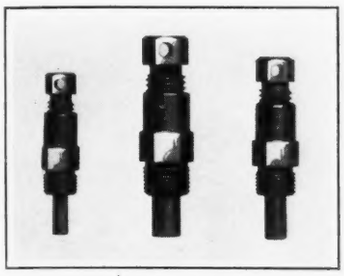


Right-angle Drill Made by the U. S. Electrical Tool Co.

"GRIPPIT"—A LOCKING OR CLAMPING DEVICE

Three sizes of a locking or clamping device known as "Grippit" are being placed on the market by the Wedge-Lock Tool Co., 2523 N. Keeler Ave., Chicago, Ill., for use on drill jigs and milling or assembly fixtures. This device consists of four parts—a shell, a plunger, a spring, and an operating screw. The shell is threaded on the outside for assembling in jigs or fixtures. On the inside it is hexagonal to receive the hexagonal head of the plunger.

One-eighth turn of the operating screw causes the plunger to advance from 1/8 to 3/16 inch. As the plunger does not rotate, the work does not move when locked and the plunger does not mar the work. When turned in the opposite direction, the plunger retreats from the work the same amount as when advanced,

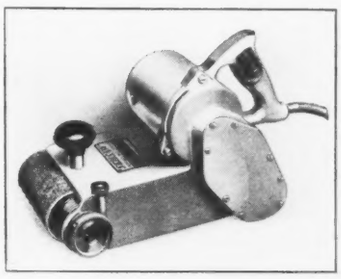


Three Sizes of the "Grippit" Locking Device

the movement being automatic. This provides 1/8 to 3/16 inch of space for loading and unloading the jig or fixture. The same amount of clearance with a screw would require three or four turns of the screw, as against less than one turn of the "Grippit."

HISEY BUFFERS WITH OPEN-TYPE SPINDLE EXTENSIONS

Model M TexDrive buffing and polishing machines are now manufactured by the Hisey-Wolf Machine Co., Cincinnati, Ohio, with open-type spindle extensions, as shown in the illustration. Except for the type of spindle extensions, these machines are of the same construction as the one illustrated in June MACHINERY, page 816. The new machines are made in 3, 5, and 7 1/2 horsepower sizes. With the gooseneck base construction, the spindle and buffing wheels extend out from the base, permitting large or odd-shaped pieces to be easily handled. The operator may stand close to the spindle or sit comfortably at the machine when the nature of the work permits.



Skilsaw Electrically Driven Hand Sander

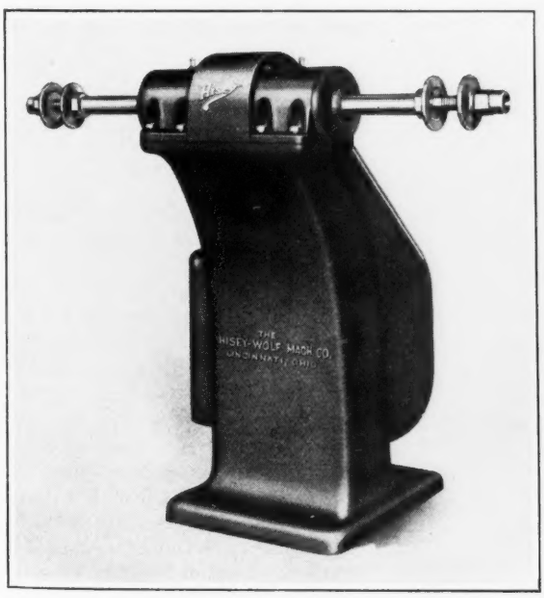
SKILSAW ELECTRIC HAND SANDER

An improved electric hand sander recently brought out by Skilsaw Inc., 3310 Elston Ave., Chicago, Ill., for use on metal, wood, and stone is shown in the accompanying illustration. One of the mechanical features of this sander is an adjustment of the front roller on an eccentric shaft, which permits belts to be changed in ten seconds. Tension is controlled by a handwheel on the side of the sander. A convenient thumb-screw adjustment provides for keeping the belt in alignment on the rollers. The air-cooled motor is of the universal type for operating from any light socket on either alternating or direct current. The net weight of this sander is about 18 pounds.

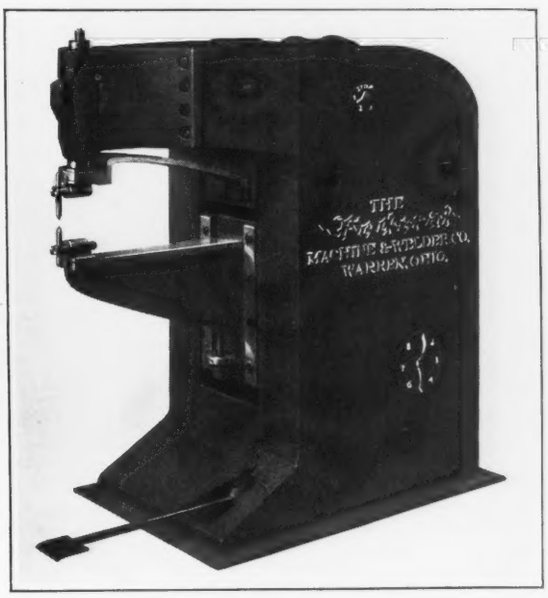
FEDERAL SPOT AND PROJECTION WELDER

One of the special features of the Senior spot and projection welder No. 2 recently developed by the Federal Machine & Welder Co., Warren, Ohio, is the design of the base, which is fabricated and welded from structural steel. With this design, considerable space and weight have been saved and it has been possible to mount the transformer, auto-coil, contactor, and regulator to better advantage.

In this new machine, the stroke of the head is adjustable to 1/2, 3/4, 1, and 1 1/4 inches. The stroke can be varied by moving a bearing block to dif-



Hisey Buffer with Gooseneck Base and Open-type Spindle Extensions



Federal Spot and Projection Welder with Adjustable-stroke Head

ferent positions in a plainly marked plate. With this feature, the maximum stroke and minimum speed can be employed for heavy spot and projection welding, and likewise, the maximum speed and minimum stroke can be used on light material. There is an unusually long dwell at the end of the stroke, which is particularly advantageous in welding non-ferrous metals. Also, a kneading action is obtainable while the metal is hot.

Spring pressures from 0 to 3500 pounds are available by changing springs. Adjustments of the pressure spring are made quickly by means of a screw at the top of the upper head, a scale indicating the pressure. A sight comparator at the front of the upper head shows whether the pressure is actually being applied, and also makes it possible to compare the pressure used with that employed on similar jobs.

The upper head can be moved manually up or down three inches by loosing a grip on the handle. This feature enables the operator to try the alignment of points or to raise the upper point over the projecting flanges or ribs on the work.

Four motor speeds of 600, 900, 1200, and 1800 revolutions per minute are available instantly. The control for the motor is mounted in the housing, with only a four-position dial visible. Any of the speeds is obtainable by merely turning this dial, and the motor is stopped similarly.

The machine is built regularly with 18 inches of throat depth, but depths of 12 and 24 inches can be provided. It will weld two pieces of 3/8-inch stock at slow speed. Five projections within an area of 7 square inches can be welded on 1/8-inch stock or lighter, when a 75-kilowatt transformer is used.

MECHANISM FOR CHAMFERING AND RECESSING GEAR TEETH

A mechanism has recently been developed by the City Machine & Tool Works, E. Third and June Sts., Dayton, Ohio, for application to the Peerless tooth chamfering machine made by the company. This mechanism enables the chamfering and intermittent cutting or recessing of gear teeth to be accomplished, and is particularly suitable for the production of those transmission parts sometimes called "drive roller spider," "main shaft third speed gear," "main drive gear," and "third and direct speed clutch." Both internal and external gears can be chamfered or intermittently cut and recessed.

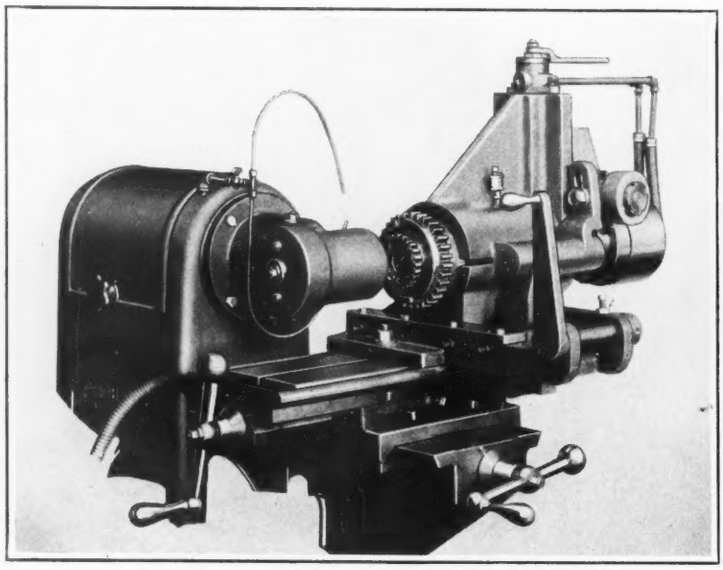


Fig. 1. Mechanism Applied to Peerless Gear Chamfering Machine for Chamfering and Recessing Gear Teeth

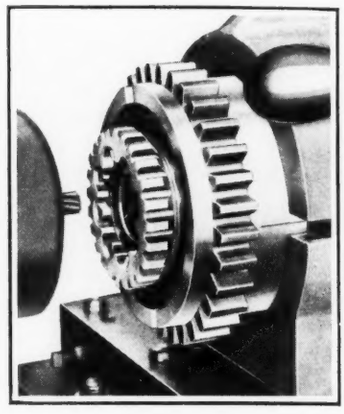


Fig. 2. Close-up View of Gear with Recessed Internal Teeth

Fig. 1 shows the entire unit with an internal gear in position just after the completion of an operation in which every second internal tooth was recessed to a depth of 3/16 inch. Fig. 2 shows a close-up view of the part itself, from which the nature of the operation can be clearly observed.

A cam furnishes the in-and-out motion which carries the gear to and from the cutter for every second tooth; however, the machine can be arranged to recess or skip practically any number of teeth.

STAMETS DOUBLE-END BORING MACHINE

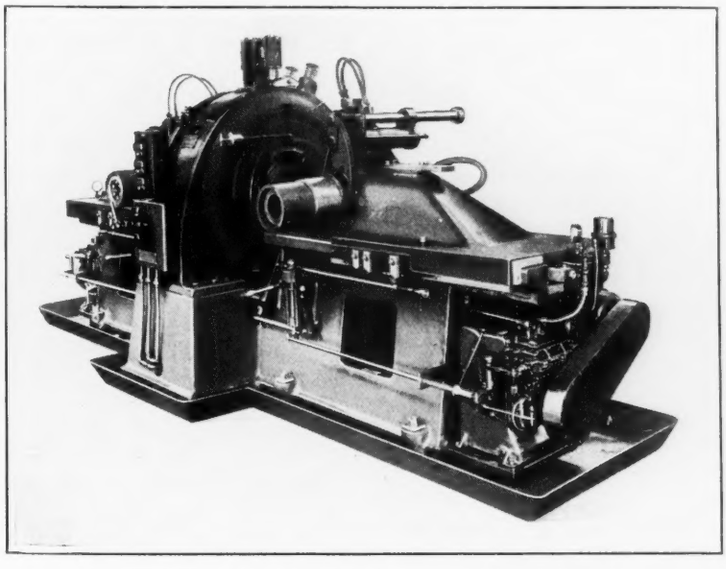
Pipe couplings and similar tapered- or straight-bored work can be bored and faced in the double-end machine illustrated, which is a recent development of William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa. This equipment consists primarily of a chuck housing mounted in the center of a bed and two boring carriages positioned one on each side of the chuck housing. The carriages are actuated by separate Oilgear pumps and cylinders which provide an automatic rapid traverse and two rates of feed. The reversal of each carriage is delayed at the

end of the stroke a sufficient amount of time for facing. The carriages slide on hardened and ground plates fastened to the bed.

The spindle of this machine is 21 inches in diameter, and is mounted in Timken tapered roller bearings said to be the largest ever used in a machine tool. Incorporated in the spindle is a power chuck which is opened or closed by means of push-buttons while the spindle is running. The spindle is driven by a 30-horsepower adjustable-speed motor through helical gears. The machine is electrically controlled, assuring convenient operation.

Loading and unloading arms swing automatically into position as the carriage is moved back from the work, these devices being actuated by compressed air. The boring heads are piloted in bushings located close to the work. An auxiliary pump supplies cutting compound at the rate of a barrel a minute under a pressure of 100 pounds per square inch. The cutting compound and chips are discharged through openings in the bed directly into a tank located below the floor level.

In the operation for which the machine is shown set up, taper-boring, recessing, facing, and chamfering cuts are taken on couplings for oil-well tubing. On an 8 5/8-inch coupling, the floor-to-floor time required is two minutes, and 37 cubic inches of high-carbon steel are removed per minute.

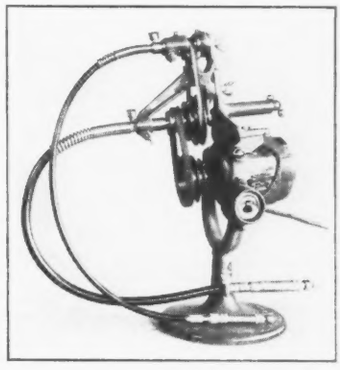


Stamets Double-end Machine for Boring and Facing Pipe Couplings and Similar Parts

KELLER TWO-SHAFT FLEXIBLE-SHAFT MACHINE

Two shafts are provided on an improved flexible-shaft machine exhibited at the New York Power Show by the Keller Mechanical Engineering Corporation, 71 Washington St., Brooklyn, N. Y. The first or lower shaft is intended for ordinary work, and will drive tools with 1/16- to 1/4-inch shafts at four speeds ranging from 875 to 3500 revolutions per minute. The upper and lighter shaft is intended for high-speed work, and may be run at speeds ranging from 5250 to 10,500 revolutions per minute. This shaft is especially suitable for fine work requiring the use of small burrs and grinding stones. Some abrasive stones used for finishing and polishing dies are only 1/8 inch in diameter, and consequently, a high spindle speed is required to give the stone a suitable surface speed.

The new light-shaft assembly may be attached to any Kellerflex machine equipped with four-speed pulleys, thereby doubling



Keller Flexible-shaft Machine with Two Shafts for Different Classes of Work

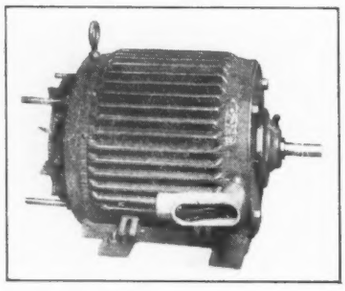
the usefulness of the equipment. The high-speed drive can be added by simply changing the overarm for one having a small pulley mounted on ball bearings. A V-belt is used for driving this small pulley from the largest jackshaft pulley.

To accommodate the small grinding stones used with the light shaft, a hand piece has been brought out which has an outside diameter of only 3/4 inch. Another development is a 10-foot flexible shaft and sheath only 1/2 inch in diameter.

LINC-WELD TOTALLY ENCLOSED FAN-COOLED MOTOR

The design of a totally enclosed fan-cooled induction motor recently developed by the Lincoln Electric Co., Cleveland, Ohio, is such that its rise in temperature is considerably less than the allowable rise for motors of this type. The design includes arc-welded steel construction, double-sealed ball bearings and a removable cover that facilitates easy cleaning of an unusually large radiating surface.

The large radiating surface is obtained by completely enclosing the sides of the motor with a deeply corrugated sheet of corrosion-resisting metal. This construction may be seen in the illustration, which shows the motor with the steel cover removed. Heat created within the motor is conducted to the radiating surface, which is constantly cooled



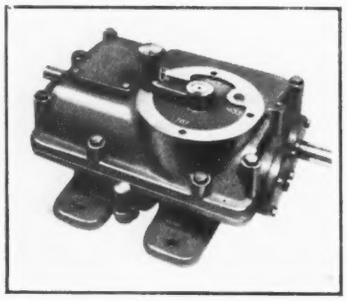
Linc-Weld Motor with Corrugated Cooling Surface

by a draft of fresh air. The air within the sealed frame is constantly circulated by a fan that is arc-welded to the rotor. The fan drives the heated air continuously against the corrugated cooling sheet. The outside air is forced over the exterior of this sheet by an arc-welded fan attached to the motor shaft. This motor is manufactured in sizes of from 1 to 50 horsepower.

ADAMS MULTI-SPEED REDUCTION UNIT

A speed reducer that differs from the conventional type in that a speed reduction and sliding gear mechanism are combined in one housing has been developed by the Adams Co., 1905 Market St., Dubuque, Iowa. This unit is suitable for applications where a constant-speed motor is used and, at the same time, various output-shaft speeds are required.

Four speed changes are obtainable through a single shift lever. Sliding gears with teeth rounded to facilitate engagement are provided. The shafts are mounted in Timken tapered roller bearings. By maintaining an oil level, the entire unit will be properly lubricated.

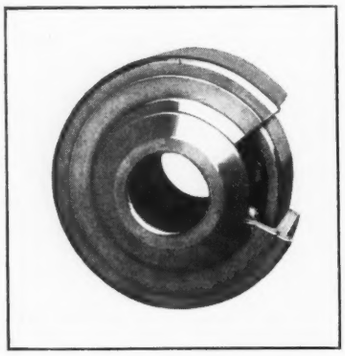


Adams Reduction Unit which Gives Four Speeds

The input and output shafts are in line on the standard unit, as illustrated, but units can be furnished with a right-angle drive. A wide variety of speeds and horsepower ratings are obtainable for each size of standard housing.

ROTATING JIG BUSHING

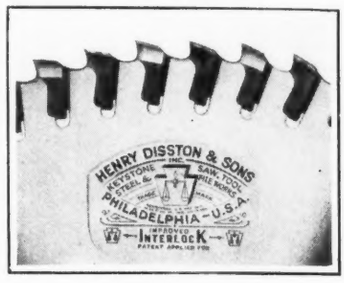
A rotating jig bushing which has a double-row ball thrust bearing has recently been placed on the market by the National Boring Tool Co., 7627 Jefferson Ave., East, Detroit, Mich. This bushing has been designed primarily for use with boring-bars equipped with tungsten-carbide tools, where it is desirable to reduce vibration to a minimum. The bushing is also particularly suitable for use in accurate reaming operations where clearance in jig bushings must be avoided. When used in core-drilling jigs, the revolving bushing guides the core drill in such a way as to reduce wear on the lands of the drill and in the bushing.



Rotating Jig Bushing with Double-row Ball Bearing

DISSTON INSERTED-TOOTH METAL-CUTTING SAW

An inserted-tooth circular metal-cutting saw which takes a draw cut instead of a thrust cut is the latest development of Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa. This saw, which is known as the "Improved Interlocked" type has the teeth set in the blade at such an angle that the cutting edges are drawn or pulled through the metal instead of being pushed through. Patents on this principle are pending. The advantages claimed are that a saw of this design cuts easily, smoothly, and quickly. The saw is intended for general work. It has proved particularly efficient in cutting large round bars and sections. It is made in various diameters.

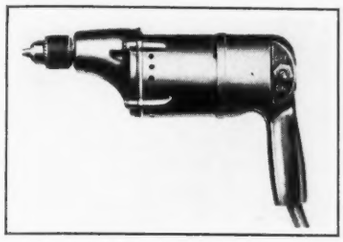


Disston Inserted-tooth Saw which Takes a Draw Cut

"LITTLE GIANT" ELECTRIC DRILLS

Drills up to 3/16 inch can be used in the "Little Giant" Nos. 18 and 19 universal electric drills which have recently been placed on the market by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. These drills were designed primarily for use in the manufacture of airplanes, automobile bodies, metal furniture, etc. With the exception of the handle and switch, they are of the same design. The No. 19 drill is equipped with the type of handle and switch illustrated, whereas the No. 18 is provided with a handle that encloses a trigger switch. Both tools are of a full-ball bearing construction and have a short over-all length.

The important specifications of the No. 18 drill are as follows: Weight, 5 pounds; over-all length, 11 3/8 inches; and spindle offset, 7/8 inch. Similar specifications of the No. 19 drill are as follows: Weight, 4 3/4 pounds; over-all length, 9 3/4 inches; and spindle offset, 7/8



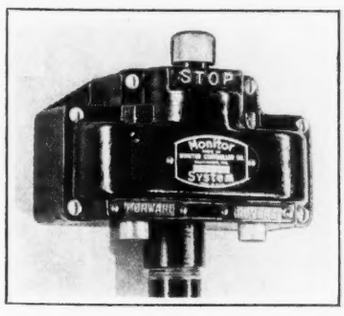
"Little Giant" Universal Drill of 3/16 Inch Capacity

inch. Each of these drills is made in two models having a free speed of 2800 and 4300 revolutions per minute and a loaded speed of 1650 and 2520 revolutions per minute.

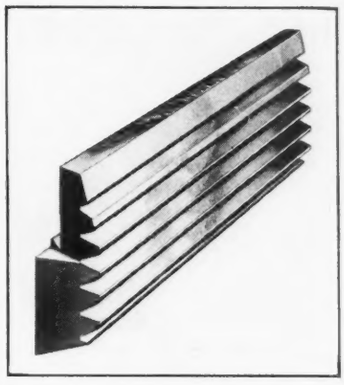
MONITOR ELECTRIC CONTROL SWITCHES

The "Ironclad" push-button master station here illustrated has been added to the line of control switches manufactured by the Monitor Controller Co., Gay, Lombard, and Frederick Sts., Baltimore, Md. This master station is available for use on either alternating- or direct-current circuits. It provides a forward and reverse momentary contact control, and is particularly suitable for machine service. Safety and convenience result from the arrangement of the buttons, the forward and reverse buttons being in a protected position at the bottom and the stop-button being on top, where it is protected and easy to operate. This arrangement enables quick-action inching in either direction.

The same company is also placing on the market at this time a new "Lotrip" switch for reverse-torque or plug-reverse braking of alternating-current motors. This switch automatically disconnects the motor from the line just before it comes to rest, and is particularly suitable for installations where the slightest motor reversal is objectionable. The device consists of a contact switch in the coil circuit of the brake-line contactor. It is held closed by pressure from an arm mounted on a friction ring. Normally, the friction ring slips and the arm exerts no pressure, but when the speed of rotation increases to a definite low value, the necessary pressure is exerted to close the brake contactor circuit until the motor slows down to the critical trip-speed.



Monitor Push-button Master Station

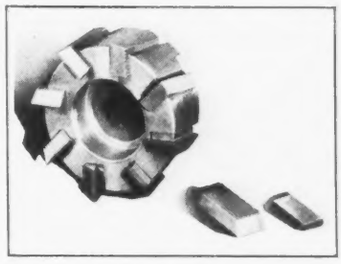


Landis Chaser with Ground Threads

LANDIS GROUND-THREAD CHASERS

A ground-thread chaser which insures an unusual degree of thread accuracy has been placed on the market by the Landis Machine Co., Inc., Waynesboro, Pa. The thread form of this chaser is ground by a new process in special machines. Minor inaccuracies and distortions resulting from the heat-treatment are removed in this process, so that a uniform thread having a flat crest and root is obtained. In addition to greater accuracy, the thread form has a freer cutting action, which increases the life of the chaser between grindings.

These ground-thread chasers are available for all sizes of Lanco and Landex heads and for the 5/8-, 7/8-, 1 1/4- and 2-inch Landmatic heads made by this company.



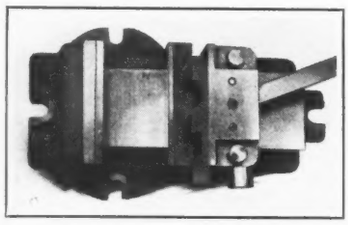
National-Cleveland Cutter with Inserted Serrated Blades

NATIONAL-CLEVELAND INSERTED SERRATED-BLADE CUTTERS

Shell end-mills and straddle-mills, face milling cutters, alternate-tooth cutters, and other cutters of special design are included in a line of inserted serrated-blade cutters now being introduced on the market by the National Tool Co., Madison Ave. and W. 112th St., Cleveland, Ohio. Some of the advantages over the old type of inserted-blade cutters made by the company with plain-back blades and round wedge pins are that the blades are now locked in position more securely; there is more blade adjustment, resulting in longer life; the blades can be more quickly adjusted or replaced; and the maintenance cost is lower.

The blades are made of hardened and ground high-speed steel; however, cutters with Stellite or tungsten-carbide blades can be furnished. The serrations on the backs of the blades are of 1/16 inch pitch and have a 90-degree included angle.

Shell end-mills of the new type can be furnished in six sizes ranging from 3 to 6 inches in diameter, and with general dimensions corresponding to the American Standard shell end-mills. Face milling cutters can be furnished in diameters of from 6 to 20 inches to fit standard spindle noses. These cutters are provided regularly with 3/8-inch blades, but heavy-duty cutters with 1/2-inch blades can be furnished. Alternate-tooth cutters and straddle-mills are made regularly in diameters of from 4 to 8 inches inclusive, but larger diameters can be provided.



Wedge-Lock Quick-acting Production Vise

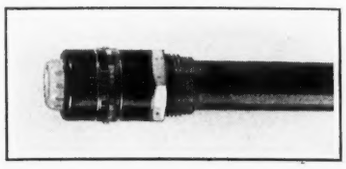
WEDGE-LOCK PRODUCTION VISE

A quick-acting vise intended for use on milling and drilling machines has been added to the products of the Wedge-Lock Tool Co., 2523 N. Keeler Ave., Chicago, Ill. This vise employs the Wedge-lock principle on the movable or locking jaw. As may be seen in the illustration, which shows the vise with the cover plate removed, there are three tapered surfaces on each jaw, one at both ends and one in the middle. The construction is such that a uniform parallel pressure is obtained between every point on the two jaws. Consequently, work of any contour, even a sphere, may be clamped securely. The opening between the jaws can be adjusted conveniently to accommodate work of different sizes.

The locking action is simple, the first seven degrees of pull on the lever serving to move the jaw forward to take up the loading space. Any further movement of the lever provides the locking action.

TRENT ELECTRICAL HEATING ELEMENTS

Electrical heating elements of the immersion type have been added to the line of industrial electrically heated equipment manufactured by the Harold E. Trent Co., 439-43 N. 12th St., Philadelphia, Pa. These heating elements, of which the Type IR Junior is illustrated, are interchangeable with other elements of a similar character. They have been designed with a view to providing the correct relationship between the area of the heating element and the outside casing, it having been found from investigation that the short life of heating elements is frequently due to the surface of the heating unit being too small to radiate the heat generated in the element.



Trent Immersion-type Electrical Heating Element

While this heating element is stocked with a seamless brass tube, bodies made of copper, steel, or chromium-alloy tubes are available. With the ordinary standard elements, the heat is distributed over the entire length of the unit, but heat concentration at different positions along the tube can be provided for.

SOFT METAL JAWS CAST TO FIT WORK

When a variety of parts are produced in small quantities, the cost for tool equipment per part may become relatively high. To overcome this disadvantage a well-known British airplane plant developed a series of universal jigs and fixtures having work-holding jaws with linings of soft metal cast to fit the part. A fixture for use in machining a forging, for example, is made with two split jaws lined with white metal or lead cast around a sample forging.

These jaws are mounted on a self-centering lathe chuck and are required to hold the work with great rigidity while the turning, boring, and facing operations are performed. The procedure in fitting the jaws with soft metal linings is as follows: A hole is bored in the bottom face of the cast-iron jaws for use in locating the self-centering jaws of the machine chuck. Then a hole is bored in a forging taken from the lot to be machined and fitted with an accurately turned plug. The opposite end of the plug is inserted in the hole in the bottom of the split jaws of the chuck. Thus the forging is located concentrically in the space inside the split jaws, and is held in the correct machining position.

The jaws, with the forging in place, are next clamped in a vise, packing pieces being placed between the chuck jaws so that they are slightly opened. The molten metal is then poured into the jaws up to a level with the top surface. The soft metal jaws produced in this manner automatically center the part to be machined and hold it securely in place.

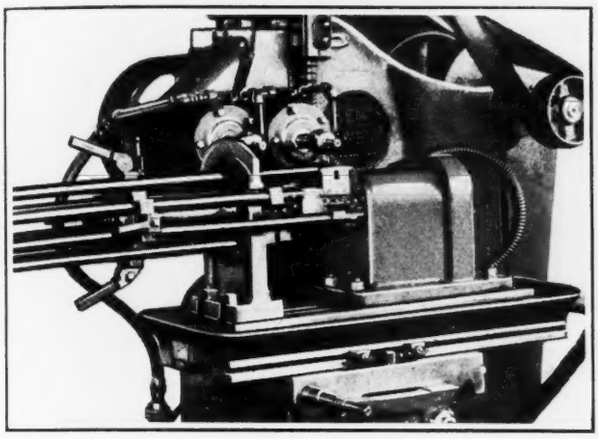
* * *

EXPORTS OF MACHINERY

The exports of industrial machinery from the United States, as reported by the Industrial Machinery Division of the Department of Commerce, are falling somewhat short of the abnormally large volume in 1929, but are in excess of the exports in 1927 and 1928. For the ten months ended October 31, 1930, which is the last month for which complete statistics are available, these exports were valued at $193,420,000 as compared with $211,640,000 for the corresponding period last year. There was, however, a gain in the exports of metal-working machinery; these exports amounted to nearly $37,000,000 for the first ten months in 1930 compared with $34,000,000 during the corresponding period in 1929. The exports of engine lathes were valued at $2,064,000; of turret lathes, $1,331,000; of milling machines, $2,867,000; and of drilling machines, $1,898,000. Forging machinery was exported to a value of $1,700,000, and power presses and other sheet-metal working machinery to a value of $3,650,000.

MILLING WOODRUFF KEYWAYS BY PRODUCTION METHODS

Woodruff keyways are milled in two automobile steering wheel shafts simultaneously at a production rate of 280 shafts per hour with the equipment here illustrated. The machine used is a Kent Owens No. 2 heavy-duty miller of the cam-feed type, which was described in August, 1929, MACHINERY, page 953. It is equipped with a special two-spindle head and an indexing fixture



Milling Woodruff Keyways in Shafts at the Rate of 280 per Hour

designed to suit the operation. The feed-cam is proportioned to meet the particular requirements of the job.

In operation, as the two-spindle head feeds downward rapidly toward the work, the fixture indexes automatically, bringing two unmilled shafts in position to be milled. When the cutters almost reach the work, the feed is slowed down for the cuts. Upon the completion of the operation, the cutters are withdrawn rapidly to their starting positions. This machine cycle can be repeated continuously or the machine can be arranged to stop at the end of each cycle.

The fixture, which holds eight steering shafts at one time, is loaded from the front of the table. It will be seen that the work support provided to the left of the cutters, is open at the front to facilitate reloading.

* * *

CYLINDRICAL AND FACE GRINDING WITH ONE WHEEL

In an operation performed on the plain grinding machine here illustrated, two cylindrical surfaces of a heavy sleeve are ground by using the periphery of the grinding wheel. Then, with the same work set-up, one face of the large collar on the sleeve is ground by applying the side of the grinding wheel. The latter step necessitates the removal of a cover on the wheel guard. The machine used for this operation was built by the Churchill Machine Co. Ltd., Broadheath near Manchester, England.

* * *

The newest thing in automobile bumpers is a device built on the principle of a pneumatic tire, said to have been marketed in France. It consists of a slightly curved steel bar to which is attached a cylindrical rubber casing containing an inner tube with air under pressure.

UNUSUAL APPLICATIONS IN THE WELDING FIELD

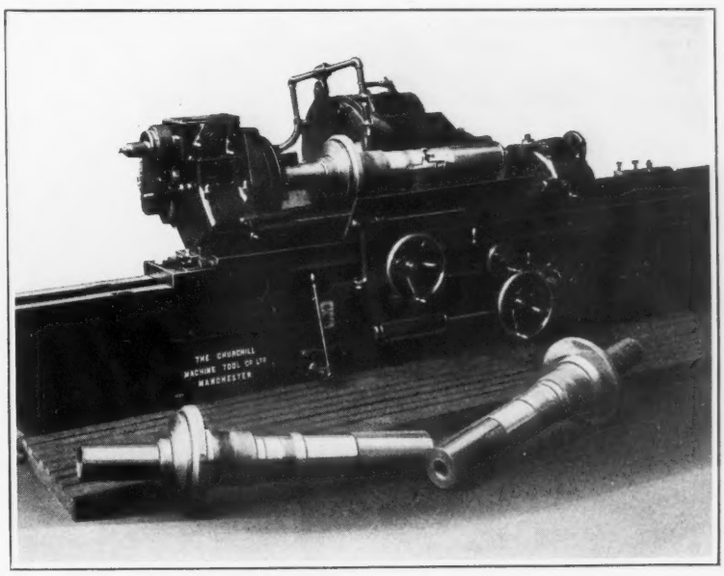
In a report presented to the International Acetylene Association, 30 E. 42nd St., New York City, by L. R. Gurley, some of the recent developments in welding were reviewed. Mr. Gurley predicted that, within ten years, the welding of ships will be common practice, and that street cars, automobiles, airplanes, and both freight and passenger railway cars will be made by welded construction.

To support this view, he referred to a number of recent accomplishments in welding. The German Government has built a naval vessel which is practically all welded. Cargo ships have been built in this country during the past year by the same process. All-welded street cars and railway tank cars are in service in France and Germany. Complete drawings for welded freight and passenger cars have been prepared by the mechanical department of a well-known railroad in this country. The freight car is an 80,000-pound capacity steel box car, and the passenger car a coach in which the entire superstructure is welded.

There has also been in operation, for over a year, a switch locomotive, the frame of which is welded. The frame sections, together with all auxiliary fittings, such as spring and brake hanger brackets, have been welded together in one piece by the oxy-acetylene process. The boiler tubes, the back flue sheet, and the water syphons, are all welded in place, as is also the engine cab and the tender, back of the locomotive. The only parts that are not welded are the boiler, the tender frame, and the front end.

* * *

The unemployment fund created by the General Electric Co., the plans for which were explained on page 108 of October MACHINERY, is now in operation and during the month of December every employe of the company, from the president to the office boy, who was working



An Operation in which One Grinding Wheel Finishes Two Cylindrical Surfaces and a Collar Face

50 per cent or more full time, contributed 1 per cent of his wages to the unemployment fund. The company matches these contributions dollar for dollar. Relief payments are being paid to employes needing assistance at a maximum rate of $15 per week at present.

PERSONALS

ARTHUR E. THORNTON, assistant secretary of the Skinner Chuck Co., New Britain, Conn., has been appointed factory manager.

G. S. MCKEE, formerly assistant factory manager of the Timken Roller Bearing Co., Canton, Ohio, has become superintendent of the Kolmar Ave. plant of the Majestic Household Utilities Corporation, Chicago, Ill.

F. D. NEWBURY, formerly manager of the power engineering department of the Westinghouse Electric & Mfg. Co., East

F. D. Newbury

Pittsburgh, Pa., has been appointed general manager of machinery engineering. R. A. MCCARTY will succeed Mr. Newbury as manager of the power engineering department. He was previously division engineer in that department.

ROBERT J. WILSON, formerly president and general manager of the Kempsmith Mfg. Co., Milwaukee, Wis., has become general manager of the Indestro Mfg. Co., Chicago, Ill., manufacturer of hardware and automotive products.

CLAXTON E. ALLEN, formerly manager of the southwestern district of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected a commercial vice-president of the company at a recent meeting of the board of directors.

BERNARD S. PATTEN, formerly sales representative in New York and New England for the V & O Press Co., Hudson, N. Y., has been appointed western district sales manager, with offices at 543 W. Washington Blvd., Chicago, Ill.

J. K. WEBB has been appointed Texas representative for the Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis., manufacturer of alternating- and direct-current automatic starters and radio resistors. Mr. Webb's office is at 601 Allen Bldg., Dallas, Tex.

WALTER F. GRAHAM has been appointed technical director of the Caskey Brass & Bronze Works, Inc., Philadelphia, Pa., agent for the International Nickel Co. Mr. Graham was previously in charge of the technical division of the Ohio Brass Co.

S. W. PARSONS has resigned as president of the Skinner Chuck Co., New Britain, Conn., to become associated with the Stanley Works of New Britain, with which he had formerly been connected for many years. He will remain on the board or directors of the Skinner Chuck Co.

RALPH S. MACPHERRAN, chief chemist of Allis-Chalmers Mfg. Co., Milwaukee, Wis., and one of the outstanding metallurgists in the field of cast iron, has been awarded the J. H. Whiting gold medal by the American Foundrymen's Association for his many valued contributions to the foundry industry.

R. W. E. MOORE, engineering manager of the association activities of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was awarded the Manufacturers' Medal and Purse for 1930, given under the James H. McGraw Award, in recognition of his contribution to the advancement of the manufacturing branch of the electrical industry.

JOHN R. GEARY, after forty-one years of service with the General Electric Co., Schenectady, N. Y., including twenty-seven years as representative of the company in Japan, has retired from active duty. Mr. Geary expects to remain in Japan for some time, and will continue to serve as a director of the Tokyo Electric Co., Ltd., and the Shibaura Engineering Works, Ltd.

ROBERT R. FENWICK of the Fenwick S. A., machinery and tool importers of Paris, France, is visiting the United States with a view to obtaining first-hand knowledge of the commercial methods in the machine tool industry in this country. Mr. Fenwick is a grandson of the late Francis Fenwick who was widely known throughout the machine tool industry in this country. He will remain here about six months, and expects to visit all the important machine tool building and manufacturing centers.

Robert R. Fenwick

HENRY P. KENDALL, president and treasurer of the Kendall Co., Boston, Mass., was re-elected president of the Taylor Society at its annual meeting at the Hotel Pennsylvania, Thursday, December 4. Mr. Kendall has been president of the Society since 1928, and was re-elected for the third successive term.

BANCROFT GHERARDI, vice-president and chief engineer of the American Telephone & Telegraph Co., was elected president of the American Standards Association at the annual meeting held at the Hotel Astor, December 11. Mr. Gherardi has been affiliated with the

R. A. McCarty

American Telephone & Telegraph Co. since 1907, and has been vice-president and chief engineer since 1920. He is a past-president of the American Institute of Electrical Engineers and of the United Engineering Societies.

S. H. TAYLOR, JR., has been placed in charge of the Los Angeles office of the Lincoln Electric Co., Cleveland, Ohio, which is located at 812 Mateo St., Los Angeles, succeeding W. S. STEWART. Mr. Stewart has been made district manager of the Cleveland territory of the company. L. P. HENDERSON has been appointed manager of the San Francisco office, and E. J. PFISTER, formerly of the Philadelphia and Allentown offices, has been made district manager of the Kansas City district with offices at 405 R. A. Long Bldg., Tenth and Grand Sts., Kansas City, Mo.

T. I. PHILLIPS, formerly superintendent of metal stamping at the A B Building of the Nuttall Works of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed works manager, succeeding H. A. HOUSTON who has resigned. W. H. HIMES, who was in the mechanical engineering department at East Pittsburgh, has been promoted to the position of manager of the engineering department, following the resignation of L. F. BURNHAM. L. R. BOTSAI has been appointed gearing apparatus manager to succeed E. E. BOON. Mr. Botsai was formerly industrial manager of the central district.

Obsolete Cutters Handicap Production —*Use Modern Cutters!*

The Cost of
Time Lost Removing Cutters
Plus Time Lost Replacing Cutters
Plus Lost Production
Plus Sharpening Cutters
Plus Original Purchase
Equals
REAL Cost of Cutters

What Is the Real Cost of Your Cutters?

It is often real economy to scrap obsolete cutters which limit the production of machines, and purchase cutter equipment whose modern design insures the utmost production per machine unit. Brown & Sharpe Cutters, because of their efficient design which gives increased capacity for work, make available the greatest possible production per hour from every man and machine. Small Tool Catalog No. 31, listing a complete line of modern cutters, will be furnished on request. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

Brown & Sharpe Cutters

Lower Production Costs

NEWS OF THE INDUSTRY

GLOBE TAPPING MACHINE CO. has moved from 488 John St., Bridgeport, Conn., to new and larger quarters at 751 Central Ave.

SHERMAN CORPORATION, business engineers, have recently removed their headquarters from Boston to 292 Madison Ave., New York City.

SIMONDS MFG. CO., 25th St., Pittsburgh, Pa., has been appointed agent for the Ramsey silent chain, and will be in a position to make prompt shipments from stock.

STRONG, CARLISLE & HAMMOND CO., 1396 W. Third St., Cleveland, Ohio, announces that the Detroit branch of the company has moved from 1300 Fort St. West to 2832 East Grand Boulevard.

LAMSON & SESSIONS CO., Cleveland, Ohio, announces the election of C. H. Longfield as vice-president, and H. H. Winterberg as secretary of the company. H. P. Ladds has been appointed manager of sales.

PANGBORN CORPORATION, Hagerstown, Md., has opened district sales offices in Cincinnati and Milwaukee. Thomas J. Dougherty has been appointed special sales engineer to cover the Hagerstown district.

COPPUS ENGINEERING CORPORATION, Worcester, Mass., has appointed G. H. Bolle district representative for the company in the New York territory. Mr. Bolle's headquarters will be at 120 Liberty St., New York City.

FULLER LEHIGH CO., a subsidiary of the Babcock & Wilcox Co., will move its manufacturing operations from Fullerton, Pa., to Barberton, Ohio, within the next few months. The executive offices will be located at 85 Liberty St., New York City.

BUNTING BRASS & BRONZE CO., Toledo, Ohio, announces that eighteen additional mill supply houses in leading industrial centers throughout the country have been appointed distributors for Bunting phosphor-bronze cored and solid bars of bearing metal.

LINCOLN ELECTRIC CO., Coit Road and Kirby Ave., Cleveland, Ohio, manufacturer of Stable-Arc welders and Link-Weld motors, has moved the Philadelphia office of the company to the Commerce Bldg. in that city. D. C. Anderson is in charge of this office.

LESTER DIE & MACHINE CO., 6545 Carnegie Ave., Cleveland, Ohio, has been organized to manufacture dies and die-casting machines, by N. Lester, formerly connected with the P and R Tool Co., Worcester, Mass. N. Lester, William Lester, and F. W. McIntyre are directors.

EX-CELL-O AIRCRAFT & TOOL CORPORATION, 1200 Oakman Blvd., Detroit, Mich., announces that a new broaching department has been added to the Ex-Cell-O plant, which is equipped to make all types of broaches and the necessary fixtures, as well as gages for checking broached parts.

AMERICAN METAL PRODUCTS CO., 34th and Burnham Sts., Milwaukee, Wis., announces that the name of the company has been changed to AMPCO METAL, INC. Extensive plans are being made for instituting new divisions that will make Ampco metal available in the form of sheet, rod, wire, forgings, etc.

U. S. TOOL & MFG. CO., 6900 Kingsley Ave., Dearborn, Mich., has awarded a contract to the Austin Co., Cleveland, Ohio, for the design and construction of a new plant on Kingsley Ave. The plant will be a one- and two-story steel frame structure for the manufacture of precision tools. It will be 100 by 200 feet in size.

CORNELL JOHNSON FORGE CO., 1659 W. 74th Place, Chicago, Ill., has been incorporated in the state of Illinois to produce and sell small drop-forgings ranging up to eight pounds in weight. The officers are as follows: A. M. Cornell, president and treasurer; T. E. Johnson, vice-president; and A. G. McCaleb, secretary.

AMERICAN MANGANESE STEEL CO., Chicago Heights, Ill., has appointed the Southern Tractor Supply Co., Durham, N. C., exclusive representative for the sale of Amsco manganese steel crawler tractor links and sprockets in the District of Columbia, North and South Carolina, eastern Tennessee, Virginia and West Virginia.

MORSE CHAIN CO., Ithaca, N. Y., held its annual banquet December 9, attended by two hundred men associated with the various Morse enterprises as department heads, foremen, and members of the office staff. Frank L. Morse, president and treasurer, gave an outline of the business conditions and predicted an industrial upturn in the Spring.

R. G. HASKINS CO., 4634 W. Fulton St., Chicago, Ill., manufacturer of flexible shaft machinery, has taken over the RAY MACHINE CO., 5403 W. Lake St., Chicago, Ill., manufacturer of electric screwdriving, nut-setting, and tapping machines. The R. G. Haskins Co. will continue the manufacture of these appliances. W. H. Ray will be associated with the Haskins Co.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., has acquired the stock and good will of the Sheet Metal Division of the Richards Co., Inc., Boston, Mass. The stocks taken over by the Ryerson organization include Armco black and galvanized sheets, lead-coated, galvannealed, and Bay State blue sheets, in addition to a diversified line of standard and special sheets.

T. B. WOOD'S SONS CO., Chambersburg, Pa., announces a new agreement entered into between this company and the Allis-Chalmers Mfg. Co., Milwaukee, Wis., whereby the T. B. Wood's Sons Co. becomes a licensed manufacturer and distributor of Texrope drives in the territory that includes Pennsylvania, Delaware, Maryland, Virginia, and parts of New York, New Jersey, West Virginia, Ohio, and North Carolina.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., will make important changes and improvements in its South Philadelphia works, involving expenditures in excess of $300,000. A new shop will be provided where all locomotive equipping and testing activity in connection with Westinghouse oil-electric and electric locomotives will be concentrated.

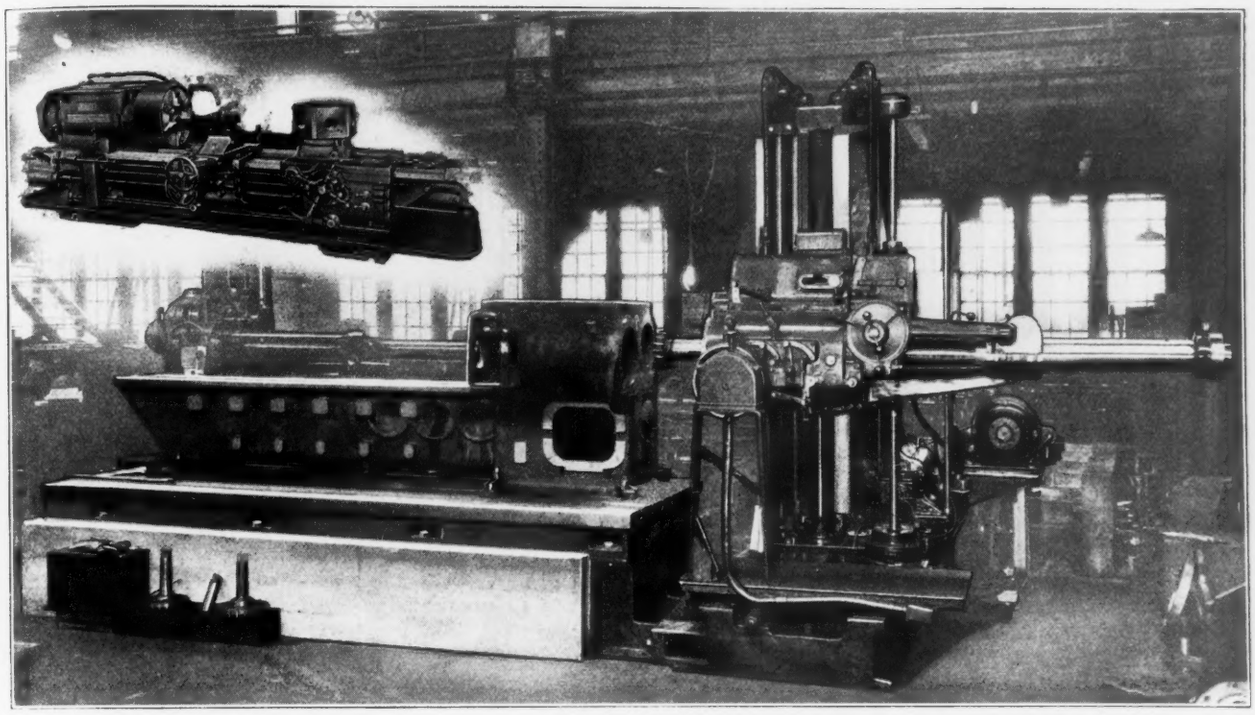
PANGBORN CORPORATION, Hagerstown, Md., in an effort to aid the unemployed, has offered to lend the city of Hagerstown $50,000 to be expended for public work, on the condition that an additional sum of $200,000 be raised for the purpose. It was suggested that a committee of three be selected by subscribers to the fund to act with the mayor in an advisory capacity in selecting the kind of work to be undertaken.

SURFACE COMBUSTION CO., Toledo, Ohio, has acquired the gas equipment division, including the foundry, of the Columbus Heating & Ventilating Co., Columbus, Ohio. The manufacturing activities will be maintained in Columbus, but the sales activities will be consolidated with the present selling organization of the Surface Combustion Co. Recently the company also acquired the Chapman-Stein Co., Mount Vernon, Ohio, in order to round out the service rendered to the steel industry.

THE CARRIER ENGINEERING CORPORATION, Newark, N. J., the BRUNSWICK-KROESCHELL CO., of New Brunswick, N. J., and Chicago, Ill., and the YORK HEATING & VENTILATING CORPORATION, of Philadelphia, Pa., three of the largest concerns in the air-conditioning, refrigerating, and unit heating and ventilating industries, have effected a merger, which, including subsidiary and affiliated companies, will unite fifteen companies with total assets of approximately $15,000,000. The holding company will be known as the CARRIER CORPORATION, and will conduct all research and sales activities for the group.

INLAND STEEL CO., First National Bank Bldg., Chicago, Ill., announces that the employes of the company have developed a plan for the relief of their fellow workers who are out of employment at the present time. Although the company has spared no effort in dividing the work among the largest possible number of employes, the volume of business does not permit all the regularly employed workers to be retained. Those who are employed have voluntarily pledged a portion of their earnings to a relief fund, and the company has agreed to contribute an equal amount. The contribution of the employes varies from about 2 to 5 per cent, according to their earnings. Those earning less than $125 a month have not been asked to contribute, except single men with no dependents. Arrangements have been made to secure the services of trained social workers who will distribute the money collected and act as advisors to the central committee of employes. The expense incurred in the distribution of the relief fund will be borne by some of the executives of the company.

This Job Requires a Precision Machine



Machining the Integral Headstock and Bed Casting for a Libby Turret Lathe

The picture above shows the standard floor type Ohio Horizontal Boring, Drilling and Milling Machine with a special raised bed arrangement used in the International Machine Tool Company plant at Indianapolis, Ind., for boring, drilling and milling the integral headstocks of Libby Turret Lathes.

As the headstock and bed are cast in one piece, extreme accuracy is required in boring out for the Timken Roller Bearings on the main spindle. This method of handling the work not only gives the required accuracy but has also considerably reduced the time required by previous methods. It assures perfect alignment of the various shaft centers and milled surfaces.

This floor type machine is built in 4″, 4½″ and 5″ spindle diameters with vertical traverse up to 7′ 0″ and horizontal traverse of post on runway to meet requirements. Bed plates, bar supports and other accessories to suit the work.

Ohio Horizontal Boring, Drilling and Milling Machines are also built in table type, planer table type, and combination floor and table type. Let us send you complete data on them. Write for descriptive bulletins.

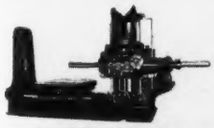
THE OHIO MACHINE TOOL COMPANY, KENTON, O.

JOSEPH T. RYERSON & SON, INC.
Chicago and Principal Cities
FINE MACHINE TOOLS
STRUCTURAL—PLATE—SHEET METAL
SHOP EQUIPMENT
RAILROAD MACHINERY
WELDERS—SMALL TOOLS

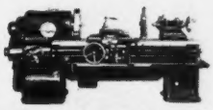
OHIO HORIZONTALS

Horizontal Drilling, Boring & Milling Machines

RYERSON MACHINERY DIVISION of GENERAL DISTRIBUTORS

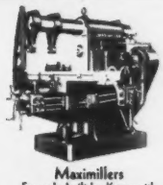


Ohio Horizontal Boring, Drilling and Milling Machines



Monotrol and Tritrol Lathes

Ohio Shapers and Planers



Maximillers
Formerly built by Kempsmith

Dreses Radials

SOLD THROUGH EXCLUSIVE LOCAL DEALERS

OBITUARIES

EMILE CHOUANARD

Emile Chouanard, head of Aux Forges de Vulcain, one of the largest and most widely known dealers in machine tools and supplies in France, now in its third generation, died last month. From a small beginning the business was built up by Mr. Chouanard during the forty-five years that he was the head, and its present standing is due largely to his business ability and strenuous application. He found time during his later years to devote to the collection of paintings, of which he had a small but beautiful collection in his house. Many friends in Europe and America will feel his loss deeply.

The present organization will continue without change, as M. Henry Bres-Chouanard has acted as general manager for more than ten years and will continue in that capacity, following the policies which have contributed to its success.

E. S. WHEELER, district sales representative in Chicago, Ill., for the V & O Press Co., Hudson, N. Y., died suddenly in Chicago on November 20, following an operation. Mr. Wheeler was forty-one years of age, and had held an executive position at the V & O factory before taking charge of the Chicago office.

AUTOMOTIVE ENGINEERS TO MEET IN DETROIT

The annual meeting of the Society of Automotive Engineers will be held at the Book-Cadillac Hotel in Detroit, Mich., January 19 to 23. Twelve distinct fields in the automotive industry will be discussed by thirty-five outstanding automotive engineers. According to present indications, over two thousand members will be present at the meeting, with many engineers coming from abroad. A special production session will be held, when L. A. Blackburn of the Oakland Motor Car Co. will present a paper on "Machine Tool Obsolescence." J. W. Brussel of the Timken-Detroit Axle Co. and A. R. Fors of the Continental Motor Corporation will collaborate with Mr. Blackburn in discussing the subject. Members, generally, will also be asked to express their ideas.

THE LINCOLN ARC WELDING COMPETITION

In November MACHINERY, page 216, an announcement was published of the Second Lincoln Arc Welding Competition. The Lincoln Electric Co., Cleveland, Ohio, states that an unusually large number of inquiries relating to the competition have been received as a result of the publicity given to it. The inquiries run into the thousands and have come from almost all industries, as well as from seventeen foreign countries. Most European countries, Australia, South Africa, Japan and China, are represented in these replies. A great many of the inquiries for further information came from Germany, where the interest in arc welding is extremely keen, as testified to by the recent launching of an all arc-welded naval vessel of the maximum size permitted by the restrictions of the treaty of Versailles.

The Second Lincoln Arc Welding Prize Competition is designed to stimulate designers and engineers in every line of industry to consider the application of arc welding to the manufacture of their own product; $17,500 will be divided into forty-one prizes. The contest closes October 1, 1931.

COMING EVENTS

JANUARY 19-23—Annual meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary, 29 W. 39th St., New York.

JANUARY 29—Annual meeting of the Steel Founders' Society of America to be held at the Hotel Hollenden, Cleveland, Ohio. G. P. Rogers, managing director, 932 Graybar Bldg., New York City.

FEBRUARY 16-20—Second National Western Metal Congress and Exposition to be held in the Civic Auditorium, San Francisco, Calif., under the auspices of the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

APRIL 13-18—Second National Industrial Equipment Exposition at the Public Auditorium in Cleveland, Ohio. Managing director, G. E. Pfisterer, 308 W. Washington St., Chicago, Ill.

APRIL 20-23—Spring meeting of the American Society of Mechanical Engineers at Birmingham, Ala. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 4-9—Annual meeting of the American Foundrymen's Association, to be held at the Stevens Hotel, Chicago, Ill. In conjunction with the meeting, a limited exhibition of foundry equipment and supplies will be held. The office of the executive secretary is 222 W. Adams St., Chicago, Ill.

MAY 7-9—Fifteenth annual meeting of the American Gear Manufacturers Association at the Hotel Statler, Buffalo, N. Y. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

JUNE 1-3—Regional meeting of the American Society of Mechanical Engineers at Hartford, Conn. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 5-6 — Annual convention of the National Association of Foremen at Dayton, Ohio. E. H. Tingley, secretary, U. B. Building, Dayton, Ohio.

CALENDARS RECEIVED

GARLOCK PACKING CO., Palmyra, N. Y., is distributing a wall calendar for 1931 to the trade.

GENERAL ELECTRIC CO., Schenectady, N. Y. Wall calendar for 1931, showing on each sheet, in attractive color plates, various applications of electricity.

WHITMAN & BARNES, INC., Detroit, Mich., manufacturer of twist drills, reamers, cutters, etc., is distributing to the trade its usual wall calendar, showing three months on each sheet.

CARNEGIE STEEL CO., Pittsburgh, Pa. Safety calendar for 1931, containing reproductions of posters submitted by school children in the annual safety poster contest held by the Carnegie Steel Co.

UNION SWITCH & SIGNAL CO., Swissvale, Pa., manufacturer of drop-forgings, is distributing its usual annual calendar to the trade. The 1931 calendar shows three months on each sheet, the current month being printed on a black background with large white numbers so that it can be easily seen at a distance.

NEW BOOKS AND PUBLICATIONS

AMERICAN NATIONAL SPECIAL SCREW THREADS. Commercial Standard CS25-30. 28 pages, 7 1/2 by 10 1/2 inches. Published by the Government Printing Office, Washington, D. C. Price, 15 cents.

THE RESISTANCE OF STEEL TO ABRASION BY SAND. By Samuel J. Rosenberg. 22 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Research Paper No. 214 of the Bureau of Standards. Price, 15 cents.

THE TORSIONAL EFFECT OF TRANSVERSE BENDING LOADS ON CHANNEL BEAMS. By Fred B. Seely, William J. Putnam, and William L. Schwalbe. 66 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 211 of the Engineering Experiment Station. Price, 35 cents.

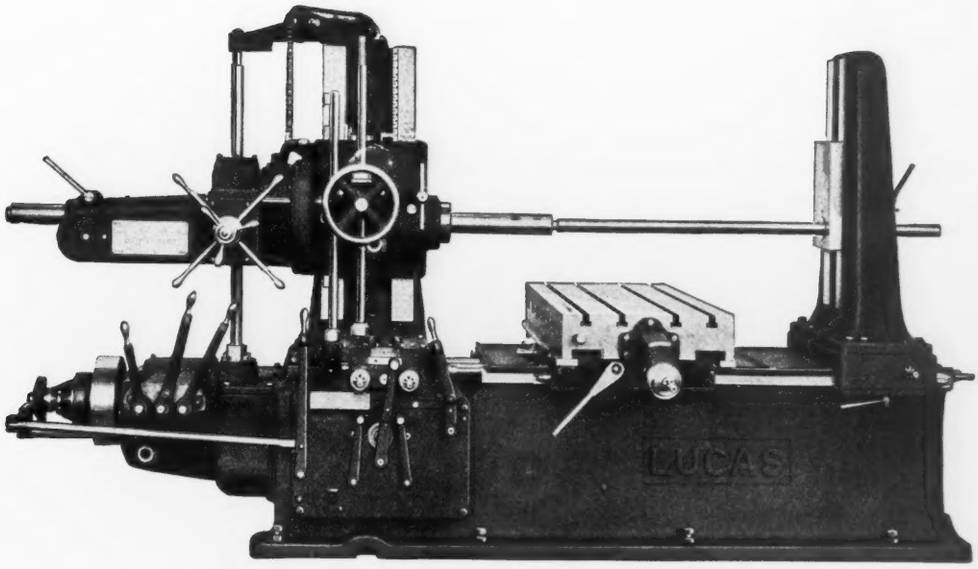
PUNCHES, DIES AND TOOLS FOR MANUFACTURING IN PRESSES. By Joseph V. Woodworth. 538 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price $5.

This is the fourth edition of a book prepared for those interested in the working of sheet metals, the design and construction of punches and dies, and the manufacture of repetition parts and articles in presses. Many examples of bending, piercing, forming, wire-drawing, ollow and other dies are shown, and a number of special tools and processes are described. This edition contains information on drop-forging and the use of modern die-sinking appliances, such as the mechanical engraving machine, as well as complete instructions for making subpress dies for watch and clock work.

THE MENACE OF OVERPRODUCTION. Edited by Scoville Hamlin. 212 pages, 6 by 8 1/2 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $2.75.

This book, dealing with overproduction and the allied problem of unemployment, is particularly timely. The economic situation throughout the world is becoming increasingly serious and the gap between world production and world consumption is growing wider and wider. Everywhere the question is being asked: "What can be done about it?" This book attempts to answer the question. The situation in eighteen different industries is discussed, each by a specialist in his particular field. These specialists give their views on the cause, extent and cures of overproduction. The situation is analyzed critically, and certain remedies are suggested.

ENGINEERING PROBLEMS. Edited by E. B. Roberts. 122 pages, 6 by 9 inches. Published by the Westinghouse Technical Night School Press, East Pittsburgh, Pa. Price, $1.60.



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Other machines may do the work, but Lucas "Precision" Boring, Drilling and Milling Machines do it with a larger profit per dollar invested. And "Precision" Machines never "pass" a dividend!

Write for convincing proof.

THE LUCAS MACHINE TOOL CO.
Cleveland, Ohio

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy. Catmur Machine Tool Corp., Ltd., London.

Lucas

"PRECISION"

Boring, Drilling and Milling Machines

This book contains a collection of engineering problems compiled by Westinghouse engineers especially for use in engineering schools. These problems have been made up from material drawn from industry and are representative of the type of problems graduates are called upon to meet in actual practice. The aim was to select problems of general interest or those that illustrate fundamental principles. The authors are as many as the fields from which the problems are drawn. Design engineers, research engineers, application engineers, management engineers, and erection engineers have all made their contributions. The material is divided into seven chapters dealing with electrical design; application; mechanical design; factory management; economic considerations; commercial policy; and thesis subjects.

NEW CATALOGUES AND CIRCULARS

HEATING EQUIPMENT. Buffalo Forge Co., Buffalo, N. Y. Catalogue 469, illustrating and describing Buffalo unit heaters for industrial use.

GASKETS. Victor Mfg. & Gasket Co., 5750 Roosevelt Road, Chicago, Ill. Circular descriptive of reinforced gaskets designed to meet special or severe conditions of service.

TAPS. Landis Machine Co., Inc., Waynesboro, Pa. Bulletins G-73 and G-74, treating, respectively, of Victor collapsible solid, adjustable taps and Victor receding chaser collapsible taps.

FLOW METERS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa., is distributing a card demonstrating the principle of operation of the electric flow meters made by this company.

AIRCRAFT EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GEA 1254 and 1293, illustrating and describing G-E Textolite molded control pulleys for aircraft and wing-edge landing lights.

FORMED MILLING CUTTERS. Brown & Sharpe Mfg. Co., Providence, R. I. Circular entitled "Production Must Be High—Operating Costs Low," illustrating applications of Brown & Sharpe formed milling cutters.

ELECTRIC LIGHT FIXTURES. O. C. White Co., 15 Hermon St., Worcester, Mass. Catalogue 31, covering a complete line of adjustable electric light fixtures and White daylight units. Price lists are included.

SHEARS AND BAR CUTTERS. Buffalo Forge Co., Buffalo, N. Y. Bulletin 330, containing data on Buffalo billet shears and bar cutters with electrically welded frames. Tables of capacities for the various types are given.

ELECTRIC MOTORS. Fuerst-Friedman Co., 1292 E. 53rd St., Cleveland, Ohio. Electric motor bargain bulletin for November, 1930, containing a complete list of the new and rebuilt equipment which this company offers for sale.

ELECTRIC CONTROL APPARATUS. Allen-Bradley Co., 1331 S. First St., Milwaukee, Wis. Bulletin 609, describing a new electric starter for alternating-current motors up to 5 horsepower 220 volts, and 7½ horsepower 440 to 550 volts.

VARIABLE-SPEED TRANSMISSIONS. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Catalogue 1274, descriptive of the New P. I. V. (positive, infinitely variable) gear, an all-metal variable-speed transmission brought out by this concern.

MATERIAL HANDLING EQUIPMENT. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Folder 1223, entitled "The Growth of Link-Belt Service to Industry." Also bulletin entitled "Pictorial Review of 1930 Developments by the Link-Belt Co."

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Catalogue 46, illustrating and describing Brown electric indicating and recording tachometers, and the electric generators used in operating them.

AIR GRINDERS AND CHIPPERS, AND DIE-CASTING MACHINES. Madison-Kipp Corporation, 203 Waubesa St., Madison, Wis. Catalogue announcing the new Kipp air chipper. The catalogue also shows Madison-Kipp automatic die-casting machines, Fresh-oil lubricators, and air grinders.

SPROCKETS. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Publication No. 1267, giving specifications of sprocket wheels which are stocked in all standard sizes, ready for immediate delivery. Boring to fit the shaft size is the only work necessary before shipping the same day the order is received.

GEARS. Charles Bond Co., 617-623 Arch St., Philadelphia, Pa. Catalogue 56, listing Bond standard stock gears, including spur gears, internal gears, worms and worm-gears, spiral gears, sprockets, etc. The booklet contains tables of dimensions and prices, as well as symbols for convenience in ordering.

THREADING MACHINES. Landis Machine Co., Inc., Waynesboro, Pa. Bulletin D-65, illustrating and describing the Landis 1 1/4- and 2-inch pipe and nipple threading machines. The salient features are shown diagrammatically by a full-page illustration of the machine with arrows pointing to the various features of construction.

TOOLS AND MACHINERY. Joseph T. Ryerson & Son, Inc., 203 West Side Ave., Jersey City, N. J. Ryerson Journal and Stock List for October, November, and December, 1930, containing data on I-beams and H-beams, structural steel, cold-finished steel, tube and boiler fittings, welded rods, rivets and bolts, building products, and tools and machinery.

CONTROLLER VALVES. Bristol Co., Waterbury, Conn. Catalogue 2002, treating of Bristol automatic controller valves of the motor-operated type. Special attention is called to the latest developments in Type BK valves for steam, water, air, and gas, described and illustrated on pages 9 to 11, as well as the adaptation of this type of valve for floating control on page 11.

WELDING ACCESSORIES. Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill. Catalogue describing a complete line of electric arc welding accessories and supplies, including cable, electrode-holders, goggles, helmets, hand shields, gloves, scratch brushes, carbon and graphite electrodes, welding putty, and welding rods. Prices are included in each case.

BALL BEARINGS. Norma-Hoffmann Bearings Corporation, Stamford, Conn. Catalogue illustrating and describing the latest developments in Norma and Norma-Hoffmann Greaseal felt-protected precision ball bearings, which are especially suitable for application in fractional horsepower motors, portable tools, domestic appliances, instruments, conveyors, and other small units.

DRILLING, MILLING, AND TAPPING MACHINES. Millholland Sales & Engineering Co., 1833 Ludlow St., Indianapolis, Ind. Publication entitled "Millholland Method of Flexible Manufacture," containing data on production methods, horsepower for driving different sizes of drills, and end thrust produced in drilling, as well as descriptions of new methods of milling and precision tapping.

AIR TOOLS. Buckeye Portable Tool Co., Dayton, Ohio. Catalogue 30, entitled "Speeding Production with Hercules Air Tools." The circular describes in detail the principle of operation of Hercules portable air tools and shows the application of these tools in grinding, polishing and sanding, drilling, reaming, screwdriving, stud-setting, etc. Specifications for the different styles of tools are included.

CUTTER AND TOOL GRINDERS. Cincinnati Milling Machine Co., Cincinnati, Ohio. Operator's Instruction Book for the Cincinnati No. 2 cutter and tool grinder. This pamphlet contains tables and data necessary for setting up and grinding all the ordinary types of milling cutters on the Cincinnati No. 2 cutter grinder. Detailed instructions for the operation, lubrication, and adjustment of the machine are given.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular 1883, covering the various types of Westinghouse small-power motors. Leaflet 20411, describing the construction, advantages, and uses of the Type UM-2 electro-magnetic line switch made by this company. This circular also describes the TA handle switch. Leaflet 1289-A, describing the latest designs of motors for looms.

HEATING MACHINES AND QUENCHING TANKS. American Gas Furnace Co., Elizabeth, N. J. Bulletin 8A, illustrating and describing the line of heating machines made by this concern. These machines are essentially heat-treating furnaces arranged with carrying or propelling devices for the transmission of work through the furnace. They are made in eight different types, all of which are illustrated and described.

TRANSMISSION EQUIPMENT. Boston Gear Works Sales Co., North Quincy, Mass. Catalogue of the Boston Gear speed reducers which are carried in stock ready for immediate delivery. Pamphlet covering the Renold-Boston line of chain drives. Leaflet containing data on adjustable shaft supports. Pamphlet listing Boston gear products, including gears, chain drives, speed reducers, shaft supports, pulleys and pillow blocks, ball bearings, joints and couplings, collars, washers, etc.

ROTARY PUMPS. Geo. D. Roper Corporation, Rockford, Ill. Catalogue containing 104 pages, illustrating and describing rotary pumps for hydraulic service, for the transfer of power, and for circulating coolant. The purposes of the different types are explained and the capacities are given in each case. Considerable general information about pumps is included, as for example, instructions for installing, data for determining the proper size and type of pump for a job, etc.

ROLLER BEARINGS. Orange Roller Bearing Co., Orange, N. J. Catalogue covering the line of roller bearings made by this concern, which includes four types, namely, staggered heavy-duty radial bearings; journal bearings using solid roll construction; plain and self-aligning thrust bearings; and tapered roller bearings. Typical applications of these bearings are shown. The main part of the catalogue consists of engineering data sheets which give complete dimensions, load capacities, fitting capacities, bearing loads at different speeds, and other useful information.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA 140A, 372A, 579B, 721, 727B, 841A, 959B, 1031B, 1193A, and 1326, illustrating and describing respectively, hand starting compensators for squirrel-cage induction motors; explosion chambers for oil-circuit breakers; automatic full-voltage controllers for synchronous motors; indoor bus supports of the porcelain post insulator type; hesitating control relays for direct-current circuits; magnetic switches; oil circuit breakers; resistor arc welders; automatic switchgear; and totally enclosed fan-cooled induction motors.